NMS SNMP Reference Manual

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Chapter 1

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1.1 Introduction

Simple Network Management Protocol (SNMP) is a protocol defined by the Internet Engineering Task Force (IETF). Network devices supporting this protocol allow a management station to monitor network status, modify network settings, and receive network events.

The *NMS SNMP Reference Manual* explains how to configure and install SNMP for NMS Communications (NMS) products. This manual is intended for customers who want to add SNMP monitoring to NMS Communications boards.

This chapter provides an overview of SNMP. Specifically, it describes the functionality of *Management Information Bases* (*MIBs*) and *agents* that are used to support SNMP on NMS hardware.

1.2 Network Management

Network management allows administrators to maintain network integrity. SNMP is an industry standard protocol that defines a method for performing network management. SNMP was initially made available for IP based enterprise networks, and is now available for telephony networks.

An SNMP network management system consists of:

- One or more *managed nodes*, running one or more SNMP *agents*. An agent keeps information about its managed node in a database called a *Management Information Base* (MIB).
- One or more network *management stations*, which run network management software and display network information. The management station is called the *host*.
- A network *management protocol*, which determines how the managed node and the management station can communicate with each other over the network.

Figure 1 shows the relationship of SNMP components:

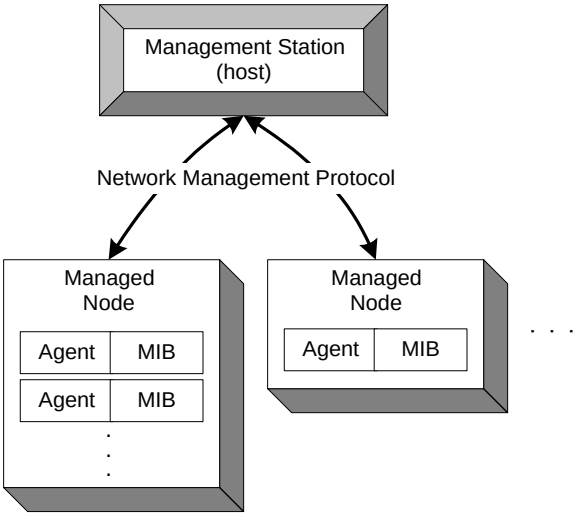

Figure 1. SNMP Network Components

In Figure 1, one management station is shown communicating with two managed nodes. The first managed node has more than one agent, and each agent has its own MIB. The dotted lines in the managed node show that there can be more agent/MIB pairs running on a managed node. The dotted lines to the right of the managed nodes show that there can be additional nodes managed by a single management station.

The following sections describe each of these components in greater detail.

1.2.1 Managed Nodes

Any device which connects to a data network and can execute the SNMP protocol can be an SNMP managed node. A managed node can be:

- A host system, such as a workstation, a printer, a file server, a terminal server, or a mainframe.
- A network router, a bridge, a hub, an analyzer or a repeater.

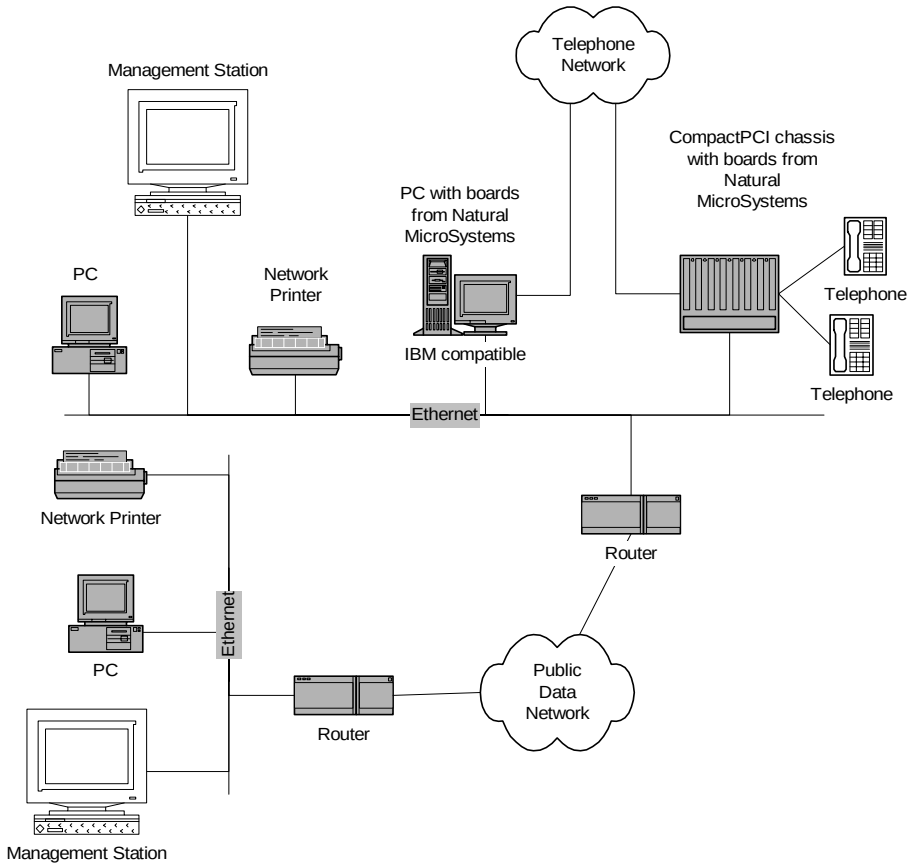

Figure 2. Managed Nodes and Management Stations

Figure 2 shows managed nodes as grey, and management stations as white.

A managed node executes a program called the SNMP service, which communicates with the management station. The SNMP service responds to messages from the host and sends unsolicited messages if a defined event occurs on the managed node.

The SNMP service is a daemon on UNIX systems and a system service on Windows NT.

The SNMP service runs one or more agents, which are applications that collect information about the managed node and keep it in a MIB. A managed node can have more than one MIB, and has one agent for each MIB.

See Chapter 2 for information about how to activate the SNMP service and load an agent.

The SNMP architecture is designed to be simple and fast. The processing load is placed on the management station, and minimized on the managed node. The set of information contained in the MIB is designed to be simple, so information about the network will not congest the network.

1.2.2 Management Information Bases

A Management Information Base (MIB) defines the information that will be maintained by the associated agent. A MIB is viewed as a database, but is actually a sequential list of managed objects. The managed objects are logically grouped to represent a row in a table, where each object in that group represents a field. The field may be a variable, or a structure of variables. Each managed object is referred to by a unique *Object Identifier* (OID).

A MIB is often shown as a tree, where the nodes of the tree define the database and its tables, rows, and fields. The collection of all MIBs is organized in a tree structure, where each node on the tree represents a single MIB. The SNMP MIB hierarchy is defined by RFC 1155 and RFC 1213. MIBs fall into two categories:

MIB	Description
Standard	A standard MIB is defined by the IETF. An example of a standard MIB is RFC 2495, the Trunk MIB.
Private	A non-standard, proprietary MIB is defined by an enterprise. The IETF assigns a unique OID number to a company, under which they can define their own OIDs for their specific products. An example of a private MIB is the NMS Communications chassis MIB.

1.2.3 Management Stations

A management station is a system running:

- The network management protocol.
- One or more network management applications.

The network management station (host) determines which information is required from the managed node. The host sends queries to a managed node to determine what information is available and to retrieve that information. The host then uses those responses to display the information in human readable form.

Host applications are much larger than agent applications, because they are designed to do most of the work in the SNMP architecture, and because one host application communicates with many agents. One example of a host management station is HP Openview.

1.2.4 Management Protocol

SNMP defines a mechanism to transport network management information. Messages containing queries and replies are sent between the host management system and managed nodes over a connectionless transport service. A commonly used transport service is User Datagram Protocol (UDP), which is part of the IP suite.

Two types of messages are supported:

Message	Description
Traversal	Provides a way for the host to read the values in an agent's MIB.
Trap	Sent by an agent to report events to the host.

Figure 3 shows the host and agent message flow:

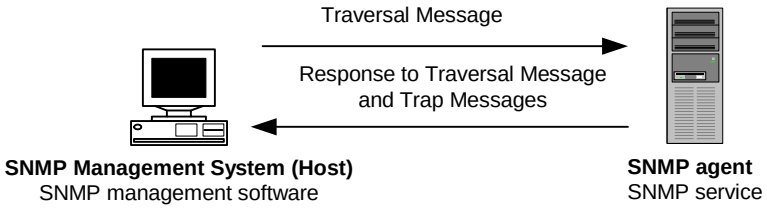

Figure 3. SNMP Message Flow

Traversal messages are generated by host commands. These commands are:

Command	Description
get	Requests a specific value (for example, the amount of hard disk space available).
get-next	Requests the next value in a MIB after using the **get** command. Useful when getting a block of related objects.
set	Changes the value of an object in a MIB. Only objects with read-write access can be set.

Trap messages are sent by an agent to notify the host about an unusual occurrence. The host can then request the value of related variables to determine more about the managed node's condition. The agent can be set to send a trap when certain conditions arise, such as an error on a line. Care must be taken to ensure that trap information does not congest the network or overwhelm the host.

Connectionless transport does not guarantee delivery, which means that traps (and other network messages) are not guaranteed to arrive at the host. You should plan your network management policies to consider lost messages.

1.2.5 Object Identifier

An object identifier (OID) is a unique sequence of integers that represents how to traverse the MIB tree to get to a managed object. All MIBs have a common root node and all OID integer sequences start from that root. The OIDs are assigned by the IETF.

The entire tree of MIBs is referred to as a *namespace*, which means that each MIB and OID is unique. The namespace for the entire tree is maintained by the IETF and related organizations, who delegate that authority only for MIBs below the Enterprises MIB, whose OID is `1.3.6.1.4.1`.

1.3 Accessing MIB Objects

Objects in a MIB can be accessed in the following ways:

Type	Description
Single	Contains a single value. Getting the value for an instance of this object type requires adding a 0 to the end of the OID. For example, if the OID to a single object type is p, then use p.0 to get its value.
Indexed Table	The column is the type of item, and the row (index) is the instance of that item type. The OID of the start of the table is p, and p.column.index describes a field, where index specifies the row.
Doubly Indexed Table	Uses two indices to specify a row. The column is the type of item and the row is defined by two indices that further define the meaning of that row. The OID of the start of the table is p. p.column.index1.index2 specifies a field, where index1 defines a set of related rows, and index2 specifies the specific row in the set of related rows.

1.3.1 Using Get-Next

The **get-next** operator finds the next object in the current MIB that has a value. It returns the value of the object and its OID. If the current object is in a table, it returns the next column, which is the last digit in the OID.

The OID to a field in an indexed table is p.column.index.

get-next retrieves the next index in the current column, until that column ends. The next **get-next** moves to the next column. These actions represent reading the table from top to bottom, then left to right.

For example, the Trunk MIB has an indexed table called the Current table, where each row is the index of the interface and each column is a statistic. If you **get** ESs for interface 1, then each **get-next** retrieves ESs for the next interface, as shown in Figure 4:

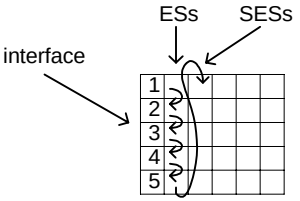

Figure 4. Indexed Table

When **get-next** has retrieved ESs for interface 5, the next **get-next** retrieves SESs for interface 1.

The OID to a field in a doubly indexed table is p.column.index1.index2. The field is grouped by index1, and the particular field in that group is specified by index2.

For example, the Trunk MIB has an Interval table, which is doubly indexed by the bus interface and the time interval. The first index is the interface, and the second index is the time interval. If you **get** ES for the first time interval of the third interface, **get-next** retrieves ES for the next time interval, as shown in Figure 5:

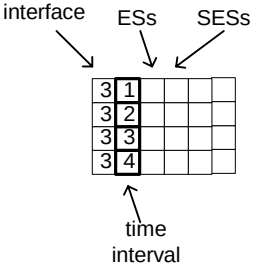

Figure 5. Doubly Indexed Table

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When **get-next** has retrieved ES for all intervals of interface 3, the next **get-next** will either get ES for the first interval of the next interface (if there is one), or SES for the first interval of interface 3.

For more information about the Current and Interval tables, refer to Chapter 4.

1.4 Supported MIBs

NMS produces agents for the following MIBs:

MIB	Description	Ownership	Installed by
Trunk	The Trunk MIB (also called the DS1 MIB), which represents DS1 (and higher speed) lines and is defined by the IETF.	RFC 2945 (obsolete RFC 1406)	OAM package
Chassis	Represents the PCI buses and slots, bus segments, and boards in the chassis. The Chassis MIB detects the presence of each board, and monitors its operational status.	Proprietary	OAM package
Software Revision	Tracks the versions of all NMS software installed in a chassis. The MIB tracks each NMS package, the files in each package, and service packs and patches applied to each package. The Software Revision MIB is modified whenever packages, service packs, or patches are installed or removed.	Proprietary	OAM package
OAM Database	Represents the contents of the NMS OAM database: board, board plug-in, and Extended Management Component (EMC) settings. The contents of the NMS OAM database can be modified via this MIB.	Proprietary	OAM package
RTP	Allows monitoring of the managed objects of the RTP system (configuration is not allowed). Displays only RTP session parameters and statistics using the NMS MSPP service. This subagent does not allow row creation or parameter modification.	RFC2959	Fusion package

NMS has been assigned a namespace under the Enterprises MIB. The OID for the NMS MIB is `1.3.6.1.4.1.2628`, under which the Chassis MIB, Software Revision MIB, and OAM Database MIB reside, and future private MIBs will be created.

Figure 6 shows a portion of the MIB tree including the NMS MIBs:

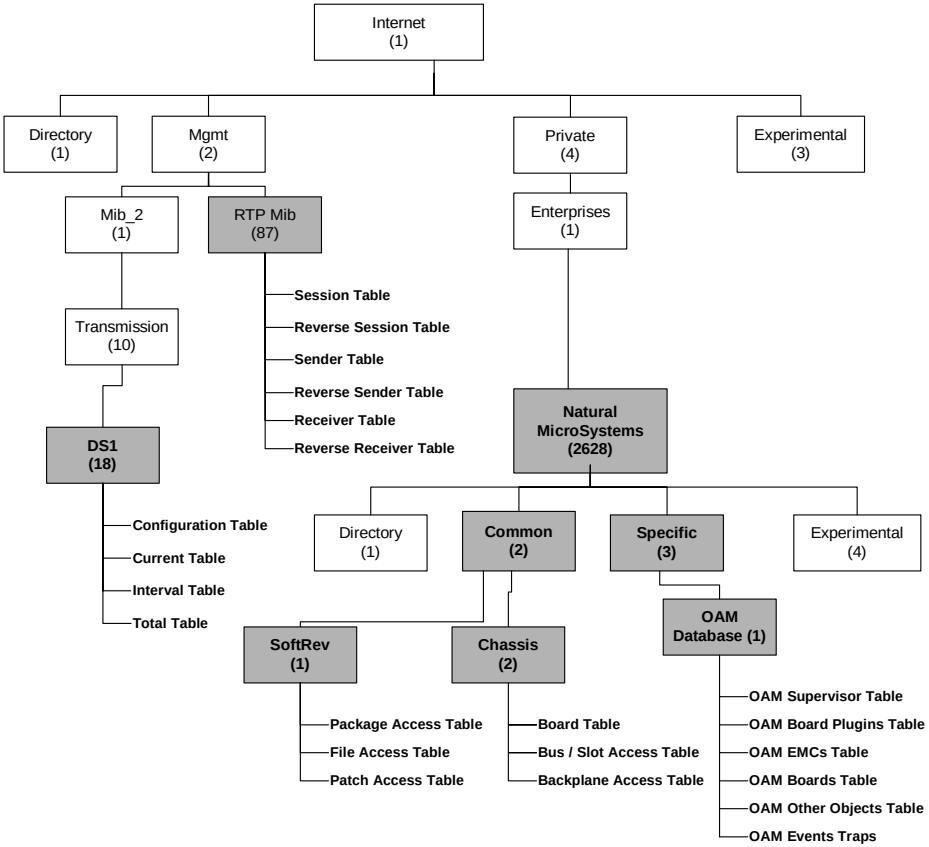

Figure 6. Enterprise MIB

In Figure 6, the SNMP subagents are shown with their major tables. The MIBs that are currently implemented are shown in grey.

The NMS subtree consists of the following MIBs:

MIB	Description
Directory	Describes all MIBs defined by NMS.
Common	Contains general-purpose MIBs, applicable across multiple product lines.
Specific	Contains specialized MIBs for individual products.
Experimental	Contains MIBs that are under development and test.

MIB description files (in ASN-1 language) for the NMS SNMP subagents can be found in the `\nms\ctaccess\doc` directory. The following table lists the MIB description files:

MIB Description File	Description
`NmsChassis.mib`	Chassis MIB
`NmsOamDatabase.mib`	OAM Database MIB
`NmsSmi.mib`	NMS hierarchy MIB
`NmsSoftRev.mib`	Software Revision MIB
`NmsTrunk.mib`	Trunk MIB (DS1)
`NmsRtp.mib`	RTP MIB (installed by Fusion package)

These text files require other MIB description files documented in RFCs (such as SNMPv2-TC, SNMPv2-CONF, SYSAPPL-MIB, etc.). These files can be easily found on the web. The NMS Communications hierarchy shown in Figure 6 is defined in the NMS-SMI MIB.

1.5 NMS SNMP Architecture

NMS SNMP consists of the following components:

- The NMS multiplexer (mux)
- NMS subagents for each MIB

As shown in Figure 7, the NMS multiplexer is located between the native SNMP master agent and the UDP port to the external network. The native master agent is

reconfigured to communicate with the NMS multiplexer instead of the external network. The NMS multiplexer communicates with the NMS subagents (one for each MIB).

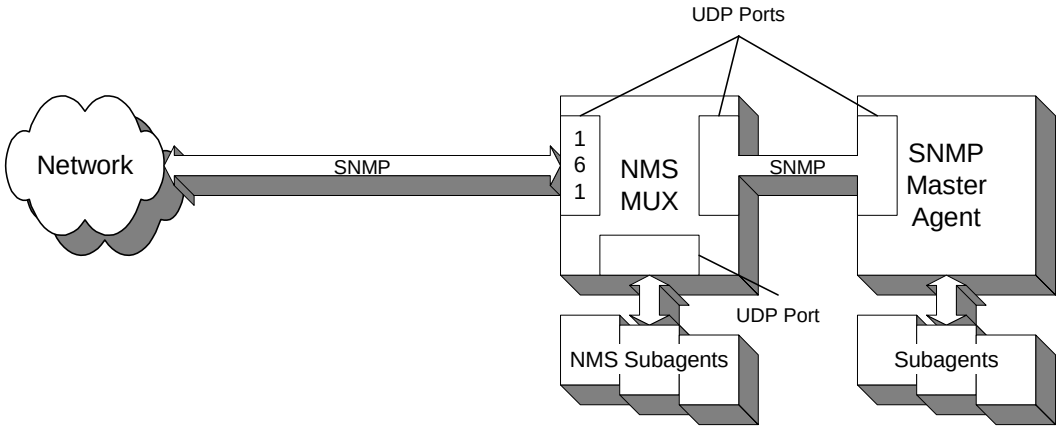

Figure 7. NMS SNMP Architecture

The NMS multiplexer handles all requests coming from the UDP network port, and communicates with the NMS subagents as needed. SNMP requests not addressed to the NMS multiplexer are routed to the native master agent. Each NMS subagent runs in a different process and exchanges information with the multiplexer using a UDP socket connection. The NMS multiplexer is thus connected to three different IP/UDP ports:

- SNMP network port (default value: 161)
- Communication port between the SNMP master agent and the multiplexer (default: 49212)
- Communication port between the SNMP subagents and the multiplexer (default: 49213)

These IP/UDP ports can be changed by editing the `snmp.cfg` file as described in Section 2.6.

The multiplexer console program, `muxC`, can read the `snmp.cfg` file and can display the currently used IP/UDP ports. It can also start and stop the agents gracefully without having to kill the process. Also, it can display all currently registered subagents.

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As shown in Figure 8, configurable IP/UDP ports allow the NMS multiplexer to be inserted in a “chain” of multiplexers, if necessary. In this configuration, each multiplexer processes incoming SNMP requests. Requests not addressed to a given multiplexer are passed to the next one.

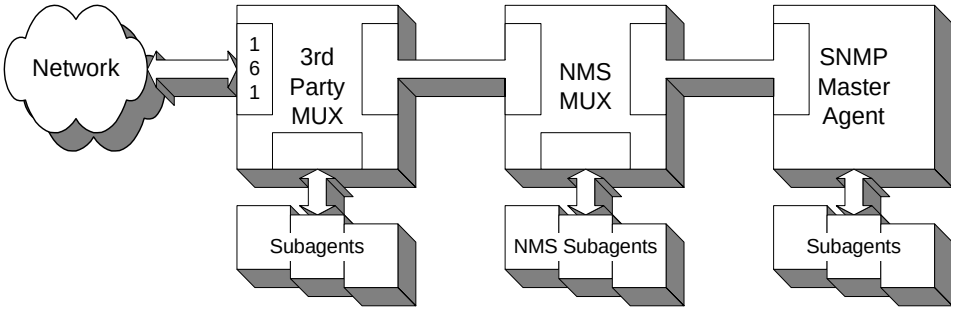

Figure 8. Multiplexer Chain

The main reasons for the multiplexer are the following:

- Uniform structure of SNMP agents and subagents
- Dynamic agent and subagent insertion, removal, and update
- Independence from differing master agent implementation and protocols under each operating system
- Uniform trap environment, adopting a SOLARIS-like approach.

Figure 9 illustrates the inner architecture of the NMS multiplexer:

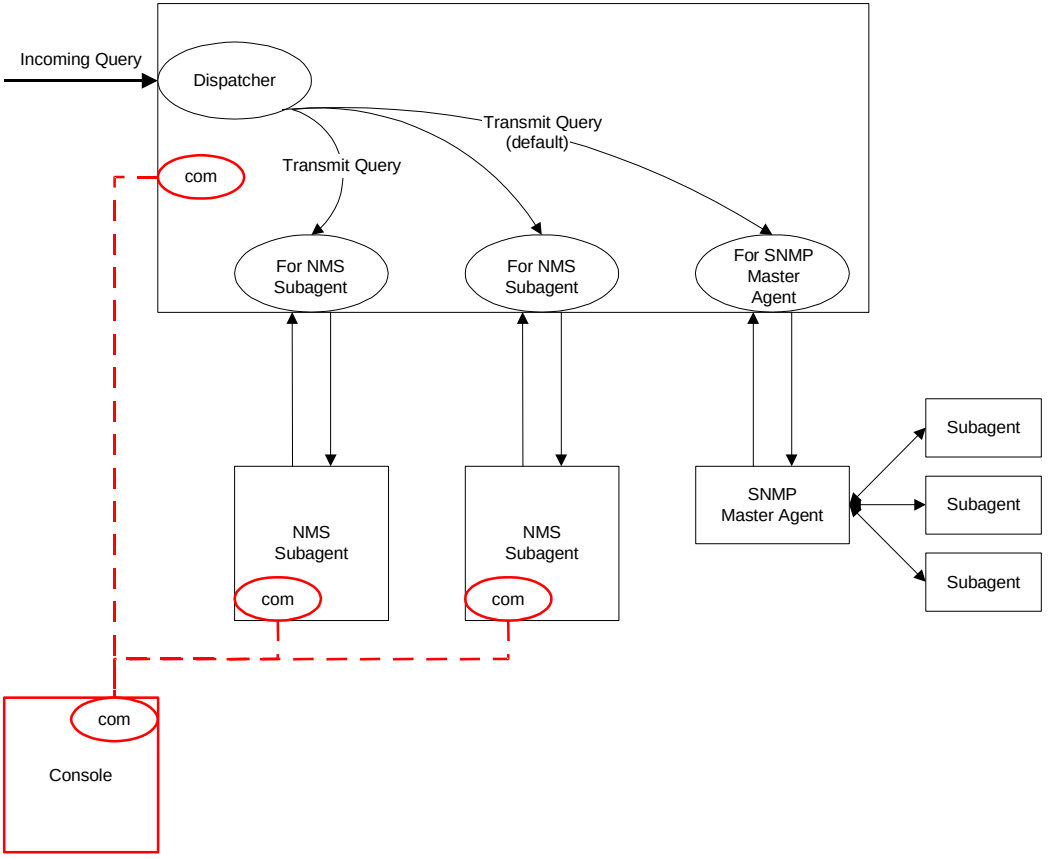

Figure 9. NMS Multiplexer Internal Architecture

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2.1 Introduction

This chapter lists procedures for installing and activating NMS SNMP software.

Note: NMS SNMP software components fully support SNMP version 1, but do not fully support SNMP version 2. For example, the **get-bulk** operator is not correctly supported, and SNMP traps are generated in version 1 format. We thus recommend that you use SNMP request version 1 when accessing NMS subagents.

2.1.1 Supported Operating Systems

NMS SNMP software is available for the following operating systems:

- Windows NT 4.0 (Service Pack 6) and Windows 2000
- SPARC Solaris
- Intel Solaris
- Red Hat Linux

2.1.2 Installation and Configuration Overview

This section outlines the steps required to install and configure NMS SNMP. Each step is described in detail in the sections that follow.

To install and configure NMS SNMP:

1. Install the SNMP master agent. By default, the master agent communicates with the network using UDP port 161:

Figure 10. Installing the SNMP Master Agent

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2. Install the NMS multiplexer (mux) and subagents:

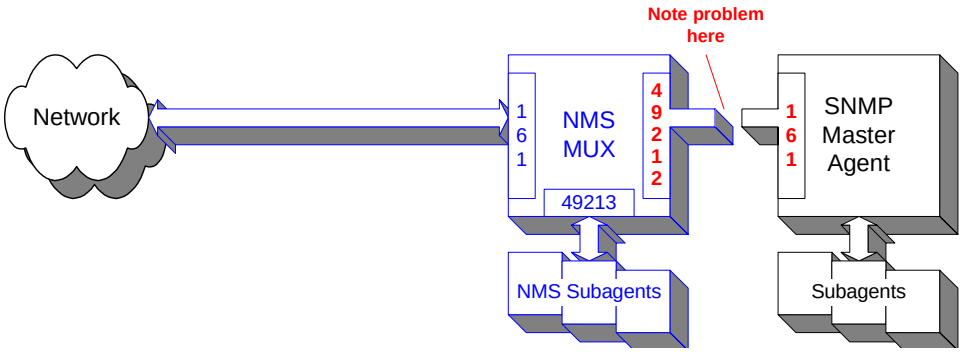

Figure 11. Installing the NMS Multiplexer

3. To set up the NMS multiplexer "between" the network and the SNMP master agent, configure the master agent so one of its UDP ports matches the NMS multiplexer. By default, the NMS multiplexer's secondary port is port 49212:

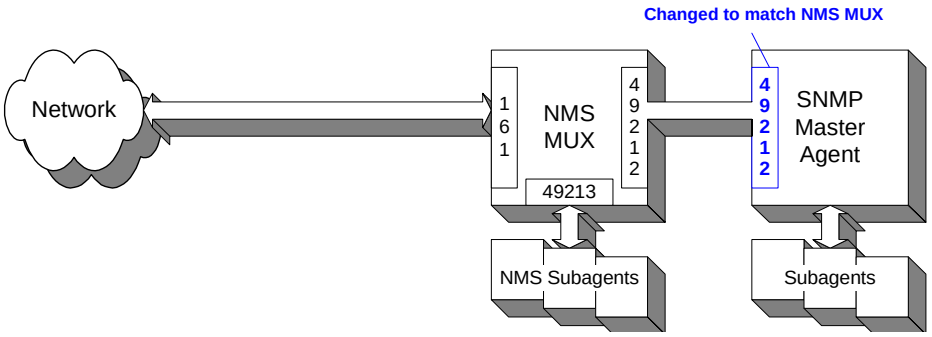

Figure 12. Configuring the SNMP Master Agent UDP Port

4. Start up the SNMP master agent, NMS multiplexer and subagents.

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5. If you wish to include a third-party multiplexer, set it up “between” the network and the NMS multiplexer, and configure the ports accordingly:

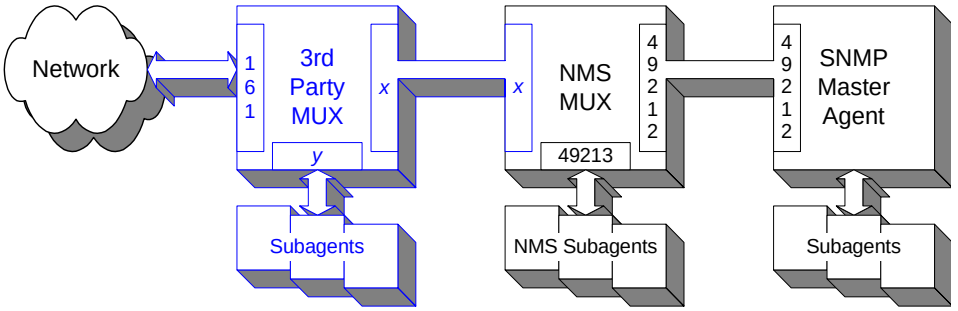

Figure 13. Configuring a Third-Party Multiplexer

Note: In all cases, all ports must be unique, and the UDP port connecting to the network must be port 161.

2.2 Installing the SNMP Master Agent

This section describes how to install, configure, and start the SNMP master agent under various operating systems.

Note: The installation and configuration procedures for NMS subagents are different from that of the master agent. To install the NMS subagents and multiplexer, refer to Section 2.3. To configure the NMS subagents, modify the file *snmp.cfg* as described in Section 2.6.

2.2.1 Windows 2000

To install, configure, and start the SNMP master agent under Windows 2000:

Note: For more detailed configuration information, see the Windows 2000 documentation for SNMP.

1. Click **Start**-->**Settings**-->**Control Panel**.

   The Control Panel window appears.

2. In the Control Panel window, double-click the Add/Remove Programs icon.

   The Add/Remove Programs dialog box appears.

3. Click **Add/Remove Windows Components** in the bar to the left of the window.

   The Windows Components Wizard dialog box appears, displaying Windows packages you can install.

4. Select the **Management and Monitoring Tools** package, and press **Next**.

   The Management and Monitoring Tools package is installed. During installation, you will be prompted to insert the Windows 2000 distribution CD.

5. (Optional) Configure the SNMP master agents. To do so:

   a. In the Control Panel window, double-click on the Administrative Services icon.

      The Administrative Services dialog box appears.

   b. Right-click on **SNMP Service**, and select **Properties** in the menu that appears.

      The SNMP Properties dialog appears.

   c. Select the **Traps** tab.

   d. Add a Community Name. For example: `public`.

   e. Add the addresses of the hosts that you wish to send traps to (if any) to the **Trap Destination** list.

   f. In the **Security** tab, you can modify the access rights.

   g. When you are finished, click **OK**.

6. Open a command prompt window.

7. Enter the following to start the SNMP service:

   ```
   net start snmp
   ```


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8. Enter the following to start the SNMP trap service:

   ```
   net start snmptrap
   ```

   The SNMP trap service is not required if you use only NMS subagents. However, you will need it if other standard subagents are attached to the master agent.

9. Enter the following to verify that the master agent is properly installed:

   ```
   netstat –a
   ```

   If the master agent is installed properly, the following appears:

   ```
   UDP    snmplab_3:snmp-trap      *:*
   UDP    snmplab_3:snmp           *:*
   ```

10. Verify that the SNMP master agent is properly installed.

    To do so, you can use any SNMP management station. You can also use the *snmpwalk* demonstration program (installed with the SNMP package) to enumerate the contents of the Mib II agents.

11. Install the NMS subagents and multiplexer as described in Section 2.3.

    Note: Make sure to add the installed components to the registry as described in Section 2.3.1.

When you first install the SNMP service under Windows 2000, the public community has only READ_ONLY access.

2.2.2 Windows NT

To install, configure, and start the SNMP master agent under Windows NT:

Note: For more detailed configuration information, see the Windows NT documentation for SNMP.

1. Install the SNMP service from the Windows NT distribution CD.
2. Add the SNMP service as a network server. To do so:
   a. Click on the Network icon in the Control Panel.

      The Network dialog box displays.

   b. Select the **Services** tab.
   c. Click **Add**.
   d. Select the SNMP service in the dialog box that appears.
   e. Follow the prompts as they appear.
3. Reinstall the version of Windows NT Service Pack you were running on your system, to ensure that you have the latest SNMP service component versions.

   Note: The SNMP service components have changed since the first release of Windows NT 4.0 (new entry points have been included).
4. (Optional) Configure the SNMP master agents. To do so:
   a. Double-click on the Network icon in the Control Panel.
   b. Select the **Services** tab.
   c. Select **SNMP Service**.
   d. Click **Properties**.

      The SNMP Properties dialog appears.

   e. Select the **Traps** tab.
   f. Add a Community Name. For example: `public`.
   g. Add the addresses of the hosts that you wish to send traps to (if any) to the **Trap Destination** list.

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h. In the **Security** tab, you can modify the access rights.

i. When you are finished, click **OK**.

5. Open a command prompt window.
6. Enter the following to start the SNMP service:

   ```
   net start snmp
   ```

7. Enter the following to start the SNMP trap service:

   ```
   net start snmptrap
   ```

   The SNMP trap service is not required if you use only NMS subagents. However, you will need it if other standard subagents are attached to the master agent.

8. Enter the following to verify that the master agent is properly installed:

   ```
   netstat –a
   ```

   If the master agent is installed properly, the following appears:

   ```
   UDP    snmplab_3:snmp-trap      *:*
   UDP    snmplab_3:snmp           *:*
   ```

   If you receive an error, it may mean that you did not reinstall the NT service pack after installing the SNMP service. Reinstall the service pack.

9. Verify that the SNMP master agent is properly installed.

   To do so, you can use any SNMP management station. You can also use the *snmpwalk* demonstration program (installed with the SNMP package) to enumerate the contents of the Mib II agents.

10. Install the NMS subagents and multiplexer as described in Section 2.3.

    Note: Make sure to add the installed components to the registry as described in Section 2.3.1.

2.2.3 Solaris

To install, configure, and start the SNMP master agent on a Solaris system:

Note: For detailed information, see the *Solstice Enterprise Agents User Guide*.

1. Log on as superuser.
2. Install the Solstice Enterprise agent access control.
3. Access a command prompt.
4. To start the master agent, enter: `/etc/init.d/init.snmpdx start`
5. Verify that the SNMP master agent is properly installed.

   To do so, you can use any SNMP management station. You can also use the *`snmpwalk`* demonstration program (installed with the SNMP package) to enumerate the contents of the Mib II agents.
6. Install the NMS subagents and multiplexer as described in Section 2.3.

2.2.4 Linux

The SNMP package has been tested using the UCD (University of Columbia at Davis) SNMP release *`ucd-snmp-4.0.1-4.rpm`*. You can find the latest UCD package at *`rpmfind.net`* or at *`net-snmp.sourceforge.net`* (previously known as *`ucd-snmp.ucdavis.edu`*) web site.

To install, configure, and start the SNMP master agent on a Linux system:

1. Install the SNMP package. To do so, access a command prompt and enter:

   ```
   rpm -i ucd-snmp-4.0.1-4.rpm
   ```
2. Start the SNMP master agent by entering:

   ```
   /etc/rc.d/init.d/snmpd start
   ```
3. Verify that the SNMP master agent is properly installed.

   To do so, you can use any SNMP management station. You can also use the *`snmpwalk`* demonstration program (installed with the SNMP package) to enumerate the contents of the Mib II agents.
4. Install the NMS subagents and multiplexer as described in Section 2.3.

2.3 Installing the NMS Subagents and Multiplexer

Once the SNMP master agent is working properly, you can install the NMS subagents and the NMS SNMP multiplexer included on the Natural Access CD-ROM. Installing the NMS OAM package from a Natural Access CD-ROM installs the NMS SNMP subagents. For information about installing Natural Access, see the installation booklet included with the CD-ROM. For further information on NMS OAM, see the *NMS OAM System User's Manual*.

When you have installed the NMS subagents and multiplexer, modify the IP/UDP port used by the SNMP master agent as described in Section 2.4.

2.3.1 Registry Modifications (Windows only)

Under Windows NT and Windows 2000, Natural Access automatically registers all installed components in the registry. When Natural Access is uninstalled, the components are automatically removed from the registry.

You can manually add or remove components from the registry. To do so, access a command prompt and enter the following command:

component_name directive

where:

- ***component_name*** is the name of the component to add. ***component_name*** can be any of the following:

Value	Description
`mux`	NMS multiplexer
`chassisAgent`	Chassis MIB agent
`ds1Agent`	Trunk MIB agent
`oamAgent`	OAM Database MIB agent
`softRevAgent`	Software Revision MIB agent
`rtpAgent`	RTP MIB agent (installed with Fusion package)

- ***directive*** indicates whether to install or remove the component. ***directive*** can be either of the following:

Option	Description
`-I`	Install the component
`-U`	Uninstall the component

For example, to remove the Chassis MIB agent from the registry, enter:

```
chassisAgent -U
```

2.4 Modifying the IP/UDP Port Used by the SNMP Master Agent

Once the NMS subagents and multiplexer are installed, modify the SNMP master agent's IP/UDP port so it connects to the NMS multiplexer port (port 49212) instead of the network port (port 161). The following sections describe how to change the SNMP master agent's port under all supported operating systems.

You can use another port if port 49212 is already in use, or if you are already using an SNMP multiplexer in your system. To configure the secondary port on the multiplexer, edit the *`snmp.cfg`* file and modify the value `MasterAgentPort` in the `[common]` section (see Section 2.6). Then restart the multiplexer and the subagents to make your changes effective.

The following sections describe how to install, configure, and start the SNMP master agent under various operating systems.

2.4.1 Windows NT and Windows 2000

To change the SNMP master agent's UDP port:

1. Open the file *`Services`* for editing. This file can be found in */WINNT/system32/drivers/etc/Services*.
2. In this file, find the following line:

```
SNMP                    161     /       udp
```


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3. Change the line to:

   ```
   SNMP                    49212  /     udp
   ```

4. Save and close this file.
5. Open a command prompt window.
6. Stop and restart the SNMP service by entering the following commands:

   ```
   net stop snmp
   net start snmp
   ```

2.4.2 Solaris

To change the SNMP master agent's UDP port:

1. Log in as superuser.
2. Open the file `/etc/init.d/init.snmpdx` for editing.
3. In this file, find the line beginning with:

   `/usr/lib/SNMP/snmpdx -p 161` ...

4. Replace the first section of the line with:

   `/usr/lib/SNMP/snmpdx -p 49212` ...

5. Save and close this file.
6. Access a console window.
7. Stop and restart the master agent, if it is running. To determine if the master agent is running, enter:

   ```
   ps -A | grep snmpdx
   ```

   If the master agent is running, the command will produce output similar to:

   ```
   136 ? 0:00 snmpdx
   ```

8. If the master agent is running, run the *`kill`* command to send a kill signal to that process, using the output of the previous command:

   ```
   kill -9 136
   ```

   Another way to stop the master agent process is by entering:
   `/etc/init.d/init.snmpdx stop`

9. Restart the master agent. To do so, enter:

   ```
   /etc/init.d/init.snmpdx start
   ```

The following is an extract of the file *init.snmpdx*:

```
#
# Copyright (c) 1997 by Sun Microsystems, Inc.
# All rights reserved.
#
#ident  "@(#)init.snmpdx        1.12    97/12/08 SMI"

case "$1" in
'start')
     if [ -f /etc/SNMP/conf/snmpdx.rsrc -a -x /usr/lib/SNMP/snmpdx ]; then
          /usr/lib/SNMP/snmpdx -p 161 -y -c /etc/SNMP/conf -d 0
     fi
     ;;

'stop')
     /usr/bin/pkill -9 -x -u 0 '(snmpdx|snmpv2d|mibiisa)'
     ;;

*)
     echo "Usage: $0 { start | stop }"
```

2.4.3 Linux

To change the SNMP master agent's UDP port:

1. Log in as superuser.
2. Open the file */etc/rc.d/init.d/snmpd* for editing.
3. In this file, find the line beginning with:

   ```
   daemon "/usr/sbin/snmpd" ...
   ```

4. Replace the first section of the line with:

   ```
   daemon "/usr/sbin/snmpd -p 49212" ...
   ```

5. Save and close this file.
6. Open a console window.

7. Now stop and restart the master agent, if it is running. To determine if the master agent is running, enter:

   ```
   ps -A | grep snmpd
   ```

   If the master agent is running, the command will produce output similar to:

   ```
   136 ? 0:00 snmpd
   ```

8. If the master agent is running, run the *kill* command to send a kill signal to that process, using the output of the previous command:

   ```
   kill -9 136
   ```

   Another way to stop the master agent process is by invoking:
   `/etc/rc.d/init.d/snmpd stop`

9. Restart the master agent by entering:

   ```
   /etc/rc.d/init.d/snmpd start
   ```

2.5 Starting the Multiplexer and the Subagents

To start the NMS multiplexer and the subagents, you can

- Use the *muxC* console program.
- Enter commands at a command prompt.

Note: Under Solaris, you must start the Solstice master agent before starting the multiplexer, because the Solstice agent will not operate if it discovers (on startup) that its IP/UDP port will be shared with the multiplexer. If the Solstice agent is started before the multiplexer, it will operate normally.

2.5.1 Starting SNMP Using muxC

To start the NMS multiplexer and subagents using *muxC*:

1. Access a command prompt.
2. Enter the following to start *muxC*:

   ```
   muxC
   ```

   The following appears:

```
**********************************
*                                *
*       MULTIPLEXER CONSOLE      *
*                                *
**********************************
A) Show the ports configuration
-----------------------------------
B) Start the SNMP Master Agent
C) Start the NMS Multiplexer
D) Start the NMS Sub-agents
-----------------------------------
E) Stop the SNMP Master Agent
F) Stop the NMS Multiplexer
G) Stop the NMS Sub-agents
-----------------------------------
H) Show the running NMS Sub-agents
-----------------------------------
I) Refresh the screen
Q) Quit the console

COMMAND> _
```


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3. Enter B to start the SNMP master agent.
4. Enter C to start the NMS Multiplexer.
5. Enter D to start the SNMP subagents.

By default, *muxC* starts and stops the SNMP subagents and the multiplexer as Windows services using the `net start` and `net stop` commands.

The *muxC* command line option `-d` causes a terminal window to be created each time you start the multiplexer and/or the SNMP subagents. The components are started in debug mode:

```
muxC -d
```

2.5.2 Starting SNMP Using the Command Line

To start the components using the command line:

1. Access a command prompt.
2. Enter the following for each component:

For this operating system type...	Enter...
Windows NT or Windows 2000	`net start` ***component_name***
UNIX	***component_name***

component_name is the name of the component to start. ***component_name*** can be any of the following:

Name	Description
`mux`	NMS multiplexer
`chassisAgent`	Chassis MIB agent
`ds1Agent`	Trunk MIB agent
`oamAgent`	OAM Database MIB agent
`softRevAgent`	Software Revision MIB agent
`rtpAgent`	RTP MIB agent (installed with Fusion package)

Under Windows NT and Windows 2000, the SNMP components are implemented as services. Under UNIX, they are implemented as daemon programs.

To obtain error information, you can start the subagents in console mode directly. To do so, specify the -d option on the command line:

```
softRevAgent -d
```

In console mode, the agent displays information like the following:

```
Inserting : .1.3.6.1.4.1.2628.2.1.1
Inserting : .1.3.6.1.4.1.2628.2.1.2.1.1
Inserting : .1.3.6.1.4.1.2628.2.1.3.1.1
Nms Snmp Software Revision Agent service started
```


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2.6 Reconfiguring the IP/UDP Ports Used by the Multiplexer

This section describes how to change the IP/UDP ports used by the NMS multiplexer, once the master agent, the NMS multiplexer, and the subagents are running.

By default, the following IP/UDP are used by the NMS multiplexer:

IP/UDP Port	Value
Communication port between the NMS multiplexer and the network	161
Communication port between the SNMP master agent and the NMS multiplexer	49212
Communication port between the NMS SNMP subagents and the NMS multiplexer	49213

These values are stored in the *snmp.cfg* file. To change the values, edit this file, as follows:

1. Locate the *snmp.cfg* file in one of the following directories:

Operating System	Directory
NT	*\nms\ctaccess\cfg*
UNIX	*/opt/nms/ctaccess/cfg/*

2. Modify the settings in the file.
3. Save and close the file.
4. To make your changes effective, restart the master agent, the NMS multiplexer, and subagents.

For more information on the *snmp.cfg* file, see Section 2.9.

2.7 Running SNMP

Once NMS SNMP is installed, in order for the software to operate:

- All Natural Access environment variables must be properly set.

  To learn about Natural Access environment variables, refer to the *Natural Access Developer's Reference Manual*.

- The DTM service must be specified in the `cta.cfg` file.

  By default, this service is specified in the file. See the *Natural Access Developer's Reference Manual* for more information about `cta.cfg`. See the *T1/E1 Digital Trunk Monitor Service Developer's Reference Manual* for information about DTM.

- The Natural Access server (`ctdaemon`) must be running.

  The NMS SNMP agents will not recognize any boards unless `ctdaemon` is running (in order to activate the NMS OAM database). Also, the agents will not report any data to SNMP requests.

  To check that `ctdaemon` is running:

  a. Access a command prompt.

  b. Enter the `ps` command, as follows:

  ```
  ps -A | grep ctdaemon
  ```

  This command produces output similar to the following:

  ```
  1028 TS 85 pts/3 0:00 ctdaemon
  ```

Note: The SNMP subagents will continue to work whether or not `ctdaemon` is running. If you restart `ctdaemon` while a subagent is running, boards will be detected (if configured). Refer to the Natural Access installation booklet and to the *NMS OAM System User's Manual* for more information about starting Natural Access and the NMS OAM service.

2.8 Stopping the NMS Multiplexer and Subagents

To stop the NMS multiplexer and subagents, you can:

- Use the *muxC* console program.
- Enter commands on the command line.

2.8.1 Using muxC

To stop the NMS multiplexer and subagents using *muxC*:

1. Access a command prompt.
2. Start *muxC* by entering:

   `muxC`

   The *muxC* console menu appears.
3. Enter H to show the NMS subagents running on the system.
4. Enter G to stop the NMS subagents.

   A list of currently running subagents is displayed. The list looks similar to the following:

```
COMMAND> g
Retrieving registered NMS SNMP subagents...
0) : name=chassisAgent oid=1.3.6.1.4.1.2628.2.2 : version=2 : port=1132
1) : name=oamAgent oid=1.3.6.1.4.1.2628.3.1 : version=1 : port=1135

Which NMS SNMP subagent would you like to stop:
```

5. Choose the subagents to stop.
6. Enter F to stop the NMS multiplexer.
7. Enter E to stop the SNMP master agent.

2.8.2 Using the Command Line

This section describes how to stop the NMS multiplexer and subagents using command line commands under Windows NT and UNIX.

Windows NT and Windows 2000

To stop the components using the command line:

1. Access a command prompt.
2. Enter the following for each component:

   `net stop` ***component_name***

   where ***component_name*** is the name of the component to stop.

Note: In debug mode (specified with the `-d` option on the command line), stop the components directly by pressing CTRL-C.

UNIX

To stop the components using the command line:

1. Access a console window.
2. Run the PS command to find a process ID for each subagent. For example, if you are running the NMS OAM Database subagent:

   ```
   ps -A | grep oamAgent
   ```

   will produce output similar to:

   ```
   136 ? 0:00 oamAgent
   ```

3. Run the **kill** command to send a kill signal to that process, using the output of the previous command:

   ```
   kill -15 136
   ```

Note: In debug mode (specified with the `-d` option on the command line), stop the components directly by pressing CTRL-C.

2.9 The SNMP Configuration File

Use the SNMP configuration file *snmp.cfg* to set the IP/UDP ports used by the multiplexer to communicate with the master agents, receive or send SNMP requests, and communicate with the NMS subagents.

You can also use *snmp.cfg* to

- Set the write access for a given subagent using a community name
- Set the trap destination for one or more subagents
- Set information specific to a given MIB (for example, the Chassis MIB information)

The *snmp.cfg* file is installed in one of the following directories:

OS	Path
Windows NT	*\nms\ctaccess\cfg*
UNIX	*/opt/nms/ctaccess/cfg*

2.9.1 Configuration File Syntax

Statements within the file appear one to a line. Any text appearing after a pound sign (#) is a comment, and is ignored. Statements are case-insensitive, except where operating system conventions prevail (for example, filenames under UNIX).

The *snmp.cfg* file is divided into multiple sections. Each section has a header, appearing in square brackets ([ ]). The statements within each section apply to one or more subagents. The sections are as follows:

Section	Subagent(s)
[common]	All subagents
[chassisAgent]	Chassis subagent only
[ds1Agent]	Trunk subagent only
[oamAgent]	OAM Database subagent only
[softRevAgent]	Software Revision subagent only
[rtpAgent]	RTP subagent only

Statements within a section each consist of a keyword name, followed by an equals sign (=) and then a value:

keyword** = **value

The [common] Section

The `[common]` section contains statements that apply to all subagents. This section contains the following keywords:

Keyword	Description	Allowed Values	Mandatory?
`SnmpPort`	Defines the port through which SNMP queries will be sent to the multiplexer	Valid UDP port number	Yes
`MasterAgentPort`	Defines the port through which the multiplexer will send SNMP requests not addressed to its subagents	Valid UDP port number	Yes
`CommunicationPort`	Defines the port used by the multiplexer, the subagent, and the console to communicate (for registration, stop or info commands)	Valid UDP port number	Yes
`access`	Defines the access rights and the defined communities that can be used to send requests to the agents.	***access*,*community*,*host*** ... where: • ***access*** defines the access right: readonly, writeonly, or readwrite • ***community*** is the name of a defined community that can be used to send requests to the agents • ***host*** specifies the name of the host where the SNMP requests are authorized. An asterisk (*) character indicates that any host is allowed.	No
`trap`	Defines the host where the trap will be sent and the community that will be used.	***community*,*host*** ... where: • ***community*** is the name of a defined community that can be used to send requests to the agents • ***host*** specifies the name of the host where the SNMP requests are authorized. An asterisk (*) character indicates that any host is allowed.	No

The Subagent-Specific Sections

aBelow the `[common]` section appear sections containing statements that apply to individual subagents only. Any configuration parameters needed by a given subagent must appear in the section for the subagent.

The `access` and `trap` keywords (defined as in the `[common]` section) can also appear in the subagent-specific sections, to define additional access and trap host settings for individual subagents only. Traps from a given subagent will be sent to all hosts listed in the section for the subagent, as well as the hosts listed in the `[common]` section.

2.9.2 Sample SNMP Configuration File

Below is an excerpt from a typical SNMP configuration file. Indentations in the file are optional, for user readability only.

```
#=========================================================================
# snmp.cfg
#
# This is an example of a file that specifies an SNMP configuration.
# This file must be placed in the nms/ctaccess/cfg directory.
#
#=========================================================================

[common]

# Definition of the UDP/IP ports used by the multiplexer to communicate with
# the Master Agent and the NMS agents.
SnmpPort = 161
MasterAgentPort = 49212
CommunicationPort = 49213

# Default access rights to the NMS agents. Format: <r/w>,<community>,<host>
access = readwrite, public, *
#access = readonly, guest, snmplab_3

# Default trap destinations for the NMS agents. Format: <host>,<community>
trap = localhost, public
#trap = snmplab_3, private

# Keep this line to allow the Multiplexer to send requests to NMS subagents:
access = readwrite, *, localhost

[chassisAgent]

# Type of chassis. Allowed values: 1=Unknown chassis
#                                  2=CPCI chassis
#                                  3=Generic PC chassis
#                                  4=Generic Sun chassis
chassType = 3

# Description string for the chassis.
chassDescr = Generic PC development computer

# Descriptions of the boards in the chassis.
# Format: <board no.>,<description string>
#boardDescr = 0, Tested 01/25/1991
#boardDescr = 1, Bad
#boardDescr = 3, Bad
```

```
# List of access rights. Format: <r/w>,<community>,<host>
#access = writeonly, private, snmplab_3

# List of trap destinations. Format: <host>,<community>
#trap = localhost, public
#trap = snmplab_3, private

[ds1Agent]

# List of access rights. Format: <r/w>,<community>,<host>
#access = writeonly, private, snmplab_3

# List of trap destinations. Format: <host>,<community>
#trap = localhost, public

[oamAgent]

# List of access rights. Format: <r/w>,<community>,<host>
#access = writeonly, private, snmplab_3

# List of trap destinations. Format: <host>,<community>
#trap = localhost, public

[softRevAgent]

# List of access rights. Format: <r/w>,<community>,<host>
#access = writeonly, private, snmplab_3

# List of trap destinations. Format: <host>,<community>
#trap = localhost, public

[rtpAgent]
# *** Note: The RTP Agent is installed with the Fusion Package ***

# List of access rights. Format: <r/w>,<community>,<host>
#access = writeonly, private, snmplab_3

# List of trap destinations. Format: <host>,<community>
#trap = localhost, public
```

Chapter 3

Chassis MIB

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3.1 Introduction

This chapter provides a detailed description of the structure and use of the NMS Chassis MIB. Section 3.5 provides a list of managed objects contained within the NMS Chassis MIB, ordered according to the MIB structure described in Figure 15.

3.2 Chassis Representation

The Chassis MIB represents the boards installed in an NMS chassis. Boards and lines (trunks) are numbered sequentially, and are assigned to tables.

The Chassis agent detects each NMS board that has both been registered to NMS OAM (*agmon* for Natural Access 3.x) and has booted correctly, and monitors its operational status. The board model, type, revision, bus segment and slot, and logical ID are represented. Removing or inserting a board (hot swap) is also monitored, and traps are sent if the status of a board changes.

3.3 MIB Structure

This section describes the tables in the Chassis MIB, and the relationship between the tables.

3.3.1 Introduction

The Chassis MIB represents a chassis as single managed node that consists of the buses, slots, and devices installed in a chassis. There are five major tables within the Chassis MIB:

Table	Description
Chassis Configuration	Provides information about the chassis.
Bus Segment	Provides information about the bus segments in this chassis.
Board Access by bus slot	Provides an index into the Bus Segment table and the Board table.
Board	Provides information about each board.
Board Access by backplane	Not implemented. (Reserved for future use.)

Figure 14 shows how the tables in the Chassis MIB are related to one another:

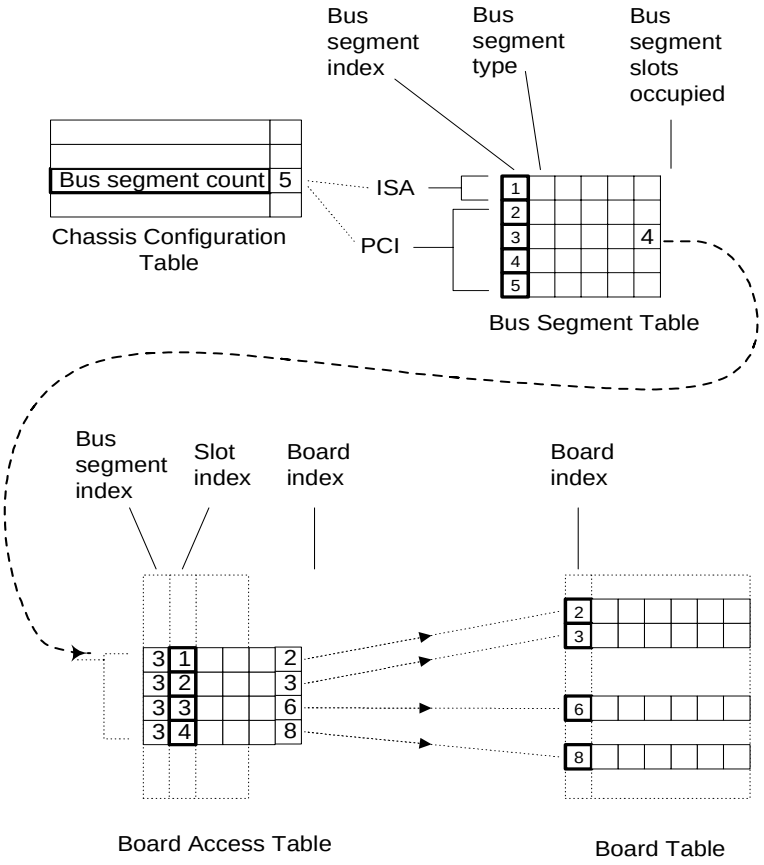

Figure 14. Chassis MIB Table Relations

Figure 14 shows that a busSegmentCount value of 5 in the Chassis Configuration table results in five entries in the Bus Segment table. Bus segment 3 has four occupied slots, so there are four entries in the Board Access table for that bus segment. Each entry in the Board Access table has a boardIndex field, whose value is an index into the Board table for that board.

Two fields in the Board table match parts of **dsx1CircuitIdentifier** in the Trunk MIB. For more information about how the Chassis MIB and Trunk MIB can be used together, see Section 3.4.

The sequence of objects in the Chassis MIB (with relative OIDs for table objects) is shown in Figure 15:

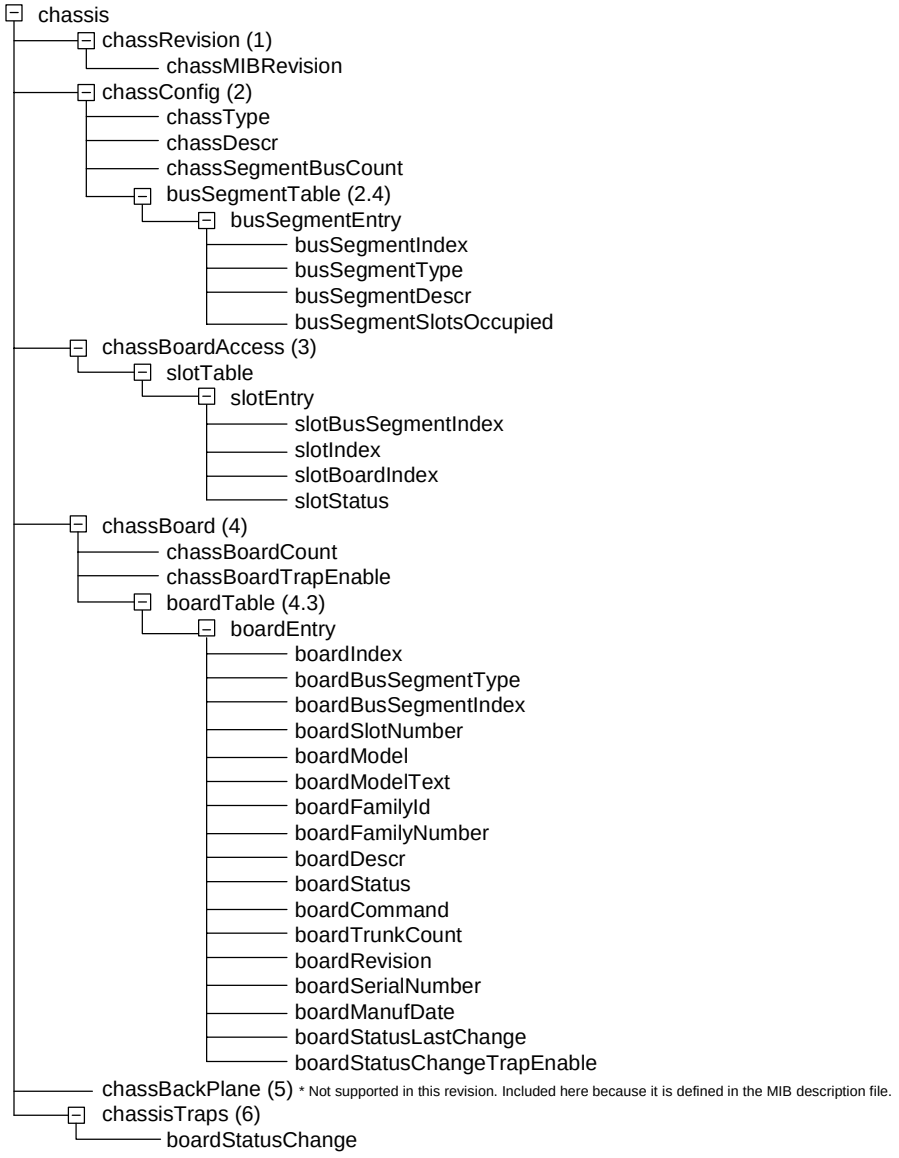

Figure 15. Chassis MIB Objects

3.3.2 Chassis Configuration Table

The Chassis Configuration table contains the following information:

- Type of chassis
- Description
- Number of bus segments within the chassis

Information about each bus segment, such as type of bus segment, description, and number of occupied slots, is contained within an object block that makes up the Bus Segment table. The objects in this table are under the **chassConfig** table of the Chassis MIB, as shown in Figure 15. Values are assigned to these objects by the NMS Chassis agent.

The objects in the Chassis Configuration table are:

Object	Description
chassConfig	Top of the table.
chassType	Chassis type.
chassDescr	Description of the chassis.
chassSegmentBusCount	Number of bus segments within the chassis.

3.3.3 Bus Segment Table

The Bus Segment table contains information about each bus segment, such as type of bus segment, description, and number of occupied slots. There can only be one ISA bus segment, but there can be many PCI (or compact PCI) bus segments.

Each **busSegmentEntry** object is identified by a **busSegmentIndex** object, whose value is assigned by the NMS Chassis agent.

busSegmentEntry objects are added to the table when a board is added to a new bus segment. If all boards are extracted, that bus segment will be deleted from the table.

Note: ISA boards are not supported by Natural Access version 4.0 and later.

The objects in the Bus Segment table are:

Object	Description
busSegmentTable	Starts the Bus Segment table.
busSegmentEntry	Starts a row of the Bus Segment table.
busSegmentIndex	Number of this row in the Bus Segment table.
busSegmentType	Bus type.
busSegmentDescr	Describes the bus segment.
busSegmentSlotsOccupied	Number of occupied slots in this bus segment.

3.3.4 Board Access Table

The Board Access table simplifies access to the Board table's variables. The Board table can be sequentially accessed by using a series of **get-next** commands starting from the beginning of the table. But this type of access is not convenient for all types of queries. For example, an application may be interested in the trunk count of all boards on PCI segment 2. Using **get-next** commands, the application must traverse the entire table in order to ensure that all boards are accounted for. With the index table, the application only needs to find the first entry with the **busSegmentNumber** that matches PCI segment 2, and the rest of that segment's boards will be listed next.

The Board Access table provides an index into the Board table that allows an application to directly access specific boards using **get** commands, based on the board's bus type, bus segment number, or logical slot number.

Object	Action
Bus Type	Examine the Bus Segment table to find the bus segment type you are interested in. Look for that entry's **busSegmentIndex** value in the Board Access table, and use each matching entry's **slotBoardIndex** value to find the entry in the Board table.
Bus Segment Number	Find the matching **slotBusSegmentNumber** in the Board Access table, and use that entry's **slotBoardIndex** value to find the entry in the Board table.
Slot Number	Find the **slotIndex** value for a chosen bus segment, and use that row's boardIndex value to index into the Board table.

The objects in the Board Access/Slot table are:

Object	Description
chassBoardAccess	Starts the Board Access table.
slotTable	Starts the rows of the Board Access table.
slotEntry	Starts a row in the Board Access table.
slotBusSegmentIndex	Number of the bus segment this board is in.
slotIndex	Logical slot index of a board in the bus segment.
slotBoardIndex	Index into the Board table for this bus segment.
slotStatus	Status of the slot (hot swap status).

3.3.5 Board Table

Each **boardEntry** object in the Board table contains information about a single board in the chassis. This group of objects includes the board model, a textual description of the board model, a family identifier, the board's status, the trunk count, the board revision, the board's serial number, and the board's date of manufacture. Each **boardEntry** is identified by the **boardIndex** object, whose value is assigned by the NMS Chassis agent. New **boardEntry** objects are added to this table and configured for NMS OAM (or added in *agmon* for Natural Access 3.x) when a board is added to the chassis.

Entries in the Board table are removed if a board physically is extracted. If a board is inserted, a new entry will be added to the Board table using the next free index. Whenever a board is inserted or extracted, a trap is sent (if traps have been enabled).

The objects in the Board table are:

Object	Description
chassBoard	Start of the board descriptions.
chassBoardCount	Number of boards in the chassis.
boardTable	Starts the Board table.
boardEntry	Starts a row of the Board table.
boardIndex	Number of this row in the Board table.
boardBusSegmentType	Type of bus segment.
boardBusSegmentNumber	Number of the bus segment this board is in.
boardSlotNumber	Number of the slot.
boardModel	Model of this board (numeric).
boardModelText	Model of this board (textual).
boardFamilyId	Family of the board.
boardFamilyNumber	Logical number of the board.
boardDescr	Board description.
boardStatus	Board status (online or offline).
boardTrunkCount	Number of trunks on this board.
boardRevision	Board revision.
boardSerialNumber	Board serial number.
boardManufDate	Date the board was manufactured.
boardStatusLastChange	When the status of the board last changed.
boardStatusChangeTrapEnable	Determines if boardStatusLastChange traps will be generated.

3.3.6 Traps Group

This is used by the agent to specify trap information. It has a valid object identifier, but does not contain usable information for developers.

3.4 Using the Chassis MIB

This section describes how to use the values in the Chassis MIB and provides other information common to more than one table.

3.4.1 Traps

Traps can be enabled to report a change in board status. The **boardStatusChangeTrapEnable** object in the Board table can be set to enable or disable traps. Traps must also be configured. See Chapter 2 for more information about configuring traps.

3.4.2 Hot Swap

Extracting a board causes the entry for that board in the Board table to be removed. If all the boards in a bus segment are extracted, that bus segment entry will be removed from the Bus Segment table. If the removed entry creates a non-contiguous numerical sequence, that number will be used the next time a board is inserted (and recognized by the agent). The Hot Swap software sees an inserted board before the agent has access to it.

Note: Hot Swap works only with the CompactPCI bus. The Hot Swap functionality described above is available only if the Hot Swap Manager is running. For more information on running the Hot Swap Manager, refer to the *NMS OAM System User's Manual*. (If using Natural Access 3.x, refer to the *Hot Swap Developer's Manual*.)

3.4.3 Board Status

Board status differs depending on which version of Natural Access you are using.

- When using Natural Access 3.x, two board status objects are used: **boardStatus** in the Board table, and **slotStatus** in the Board Access by slot table. **boardStatus** provides a simple (online, offline, or pending) message, and **slotStatus** gives a finer grain value, the Hot Swap state. For more information about Hot Swap states, see the *Hot Swap Developer's Manual*.
- In Natural Access 4.0 (or later), **boardStatus** and **slotStatus** are identical, and their functionality is equivalent to that of **slotStatus** under CT Access 3.x.

The two objects tie together by an index value. **boardIndex** in the Board table matches the **slotBoardIndex** in the Board Access by slot table.

3.4.4 Linking to the Trunk MIB

dsx1CircuitIdentifier in the Trunk MIB (RFC 2495) contains the name of the board that the line is on, as well as a board number and trunk number. The board text portion maps to the **boardFamilyId** in the Chassis MIB, and the board number maps to the **boardIndex** in the Chassis MIB (both objects are in the Board table).

For example:

dsx1CircuitIdentifier = AG_Dual_T1_02_01

boardModelText = AG_Dual_T1

boardFamilyNumber = 2

In this example, **dsx1CircuitIdentifier** says that the trunk is on an AG_Dual_T1 board, the family number is 2, and the trunk number is 1 (trunk number has no direct match in the Chassis MIB).

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3.5 Chassis MIB Node Tables

The following sections describe the objects in this MIB. A typical object description includes:

Syntax	The datatype of the object is shown. SNMP data types include:	
	• Integer	16-bit signed.
	• DisplayString	ASCII text.
	• Gauge	Positive integer from 0 to 4294967295 (2^{32} - 1).
	• Object	Another object type from this MIB.
	• TimeStamp	Positive integer from 0 to 4294967295 (2^{32} - 1).
Access	The type of access allowed for this object. Options are:	
	Read-only	This object can not be modified by SNMP.
	Read-write	SNMP can configure this object.
OID	The OID defines the path from the root to this object. All OIDs start with ***p***, where ***p*** is is `1.3.6.1.4.1.2628.2.2` (the OID for the Chassis MIB).	
Description	Describes the object.	
Configuration	Describes how to configure the object.	

The source from which the NMS MIBs was compiled is supplied with the software, in ASN1 format text files. These files can be found in `\nms\ctaccess\doc` (`/opt/nms/ctaccess/doc` under UNIX). The Chassis MIB was compiled from `chassis-mib.txt`. Read this file using the Windows NT Console Management function to display the SNMP information for this proprietary agent.

chassRevision

Syntax	Object
Access	Not accessible
OID	***p***.1
Description	Starts a group for the revision field.
Configuration	Not applicable.

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chassMIBRevision

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.1.1

Description Revision ID of the Chassis MIB. The value of the revision ID (set by NMS) is `Wednesday, May 24, 2000` (for Natural Access 3.x the value is `Tuesday, May 04, 1999`). This object identifies the MIB, so the management station can tell if it is configured for the correct MIB.

Configuration Not applicable.

Note: In versions of the software prior to 2001-1, the OID for this node was ***p***.1.

chassConfig

Syntax	Object
Access	Not accessible
OID	***p***.2
Description	Starts a group of three objects that describe the chassis.
Configuration	Not applicable.

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chassType

Syntax Integer

Access Read-only

OID ***p***.2.1

Description Indicates the chassis type:

Value	Description
1	Unknown chassis (default).
2	CompactPCI chassis.
3	Generic PC chassis.
4	Generic Sun chassis.

The chassis type is specified in the *snmp.cfg* configuration file. The keyword and value are:

```
ChassisType = [1|2|3|4]
```

Configuration This object is configured by editing *snmp.cfg* before starting the NMS Chassis agent.

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chassDescr

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.2

Description Textual description of the chassis. The default value is the empty string. An example string could be:

```
CPCI chassis; location: Floor 2 West Wing
```

The chassis description is specified in the *snmp.cfg* configuration file. The keyword and value are:

```
ChassisDescription = Description
```

Configuration This object is configured by editing *snmp.cfg* before starting the NMS Chassis agent.

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chassSegmentBusCount

Syntax Integer

Access Read-only

OID ***p***.2.3

Description Number of known bus segment types (ISA bus and/or PCI segments) in the chassis. The default value is `0`, there are no boards in the chassis. There can only be one ISA bus segment, but there can be more than one PCI bus segment. This value determines how many entries there will be in the Bus Segment table.

This object is updated when a board is inserted into a slot in a previously unpopulated bus segment and is recognized by the agent, or when a board is removed.

Configuration Not applicable.

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busSegmentTable

Syntax	Object
Access	Not accessible
OID	***p***.2.4
Description	Starts a sequence of **busSegmentEntry** objects that compose a row in the Bus Segment table. It is composed of exactly ***n*** **busSegmentEntry** objects, where ***n*** = **chassSegmentBusCount**.
Configuration	Not applicable.

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busSegmentEntry

Syntax	Object
Access	Read-only
OID	***p***.2.4.1
Description	Starts a row in the Bus Segment table. A **busSegmentEntry** object block is added to the Bus Segment table when a board is inserted into a slot on a previously unpopulated bus. This object and the associated block of objects is removed when a board is extracted from the bus.
Configuration	Not applicable.

busSegmentIndex

Syntax	Integer
Access	Read-only
OID	***p***.2.4.1.1.***n***, where ***n*** ranges from 1 to the number of bus segments
Description	Identifies this row in the Bus Segment table. Internally assigned by the agent. The value range is 1<= ***n*** <= **chassSegmentBusCount**.
Configuration	Not applicable.

busSegmentType

Syntax Integer

Access Read-only

OID ***p***.2.4.1.2.***n***, where ***n*** ranges from 1 to the number of bus segments

Description Indicates the bus type. Valid values are:

Value	Type
1	ISA bus (not supported in Natural Access versions 4.0 and later)
2	PCI or CompactPCI bus

Configuration Not applicable.

busSegmentDescr

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.2.4.1.3.***n***, where ***n*** ranges from 1 to the number of bus segments
Description	Textual description of the Bus Segment. The value will either be: `PCI bus segment number: 0` or `ISA`.
Configuration	Not applicable.

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busSegmentSlotsOccupied

Syntax	Integer
Access	Read-only
OID	***p***.2.4.1.4.***n***, where ***n*** ranges from 1 to the number of bus segments
Description	Number of occupied slots in this entry's bus segment. This value determines the number of entries in the Board Access by slot table for this bus segment. Updated by the agent when a board is inserted into or extracted from the associated bus segment.
Configuration	Not applicable.

chassBoardAccess

Syntax	Object
Access	Not accessible
OID	***p***.3
Description:	Starts the sequence of objects that make up the Board Access table in the Chassis MIB.
Configuration	Not applicable.

slotTable

Syntax Object

Access Not accessible

OID ***p***.3.1

Description This object starts a sequence of **slotEntry** objects that make up the Board Access table. The Board Access table provides an index into the Board table (**slotBoardIndex**), allowing direct access to a specific board based on its bus characteristics.

This table is composed of exactly ***n*** * ***m*** **slotEntry** objects where:

n = **chassSegmentBusCount** (from the Chassis table)

and

m = **busSegmentSlotsOccupied** (from the Bus Segment table)

Configuration Not applicable.

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slotEntry

Syntax Object

Access Not accessible

OID ***p***.3.1.1

Description Starts a row in the Board Access table.

A **slotEntry** block of objects is added to the Board Access table whenever a board is inserted, and removed when a board is extracted.

Objects belonging to this entry belong to a Doubly Indexed table, and are accessed using an OID of:

`p.3.1.1.`***x*****`.`*****n*****`.`*****m***

where

x = the object of the group and the column number of this row.

n = the bus segment number (**slotBusSegmentIndex**), the first index.

m = the slot number (**slotIndex**), the second index.

For more information about Doubly Indexed tables, see Section 1.3.

Configuration Not applicable.

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slotBusSegmentIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.1.***n*** . ***m***, where ***n*** is the index of this segment in the Bus Segment table, and ***m*** is the index of the slot in this segment.
Description	Identifies the bus segment to which this slot belongs. Corresponds to **busSegmentIndex** in the Bus Segment table.
Configuration	Not applicable.

slotIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.2.***n***.***m***, where ***n*** is the index of this segment in the Bus Segment table, and ***m*** is the index of the slot in this segment.
Description	The logical index of a slot within the bus segment.
Configuration	Not applicable.

slotBoardIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.3.***n***.***m***, where ***n*** is the index of this segment in the Bus Segment table, and ***m*** is the index of the slot in this segment.
Description	Index into the Board table for the board in the associated bus segment and logical slot. Matches **boardIndex** in the Board table.
Configuration	Not applicable.

slotStatus

Syntax Integer

Access Read-only

OID ***p***.3.1.1.4.***n***.***m***, where ***n*** is the index of this segment in the Bus Segment table, and ***m*** is the index of the slot in this segment.

Description The Hot Swap status, from the Hot Swap state diagram. Acceptable values are:

Value	Status
1	Online.
2	OnLine Pending. The board coming online is in progress.
3	Failed.
4	Offline. The board is turned off, and can be extracted.
5	Offline Pending. Waiting for activity to stop, which can be time consuming.
6	Extracted.

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For Natural Access 3.x, acceptable values are:

Value	State	Description
1	P0	Board is not present in the slot.
2	S0	Board is present, but not configured for Hot Swap.
3	S1	Hot Swap device instance is not started.
4	S1F	The Hot Swap device instance failed to start.
5	S1I	The Hot Swap device instance is started, but the board is not prepared for use (insertion is in progress).
6	S1B	Board is being prepared (insertion is in progress).
7	S1BF	Board preparation failed.
8	S2	Board is ready.
9	S2R	Extraction in progress.

Configuration Not applicable.

chassBoard

Syntax	Object
Access	Not accessible
OID	***p***.4
Description	Starts the series of variables that constitutes the Board table.
Configuration	Not applicable.

chassBoardCount

Syntax	Integer
Access	Read-only
OID	***p***.4.1
Description	Number of boards currently installed in the chassis. Corresponds to the number of **boardEntry** objects, which starts a row in the table. Incremented when a board is inserted, and decremented when a board is extracted.
Configuration	Not applicable.

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chassBoardTrapEnable

Syntax Integer

Access Read-write

OID ***p***.4.2

Description Sets the default value for the **boardStatusChangeTrapEnable** object for the entries in this table.Valid values are:

Value	Description
1	Enabled
2	Disabled (default)

Configuration Not applicable.

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boardTable

Syntax Object

Access Not accessible

OID ***p***.4.3

Description Starts a sequence of **boardEntry** objects, which defines the rows of the Board table. The Board table contains configuration and status information for all boards in the chassis.

This table consists of exactly ***n*** * ***m*** **boardEntry** entries where:

n = **chassSegmentBusCount**

and

m = **busSegmentSlotsOccupied**

Configuration Not applicable.

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boardEntry

Syntax	Object
Access	Not accessible
OID	***p***.4.3.1
Description	Starts the series of objects for a row in the Board table. A **boardEntry** variable is added to the Board table whenever a board is inserted, and removed from the table when a board is extracted.
Configuration	Not applicable.

boardIndex

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.1.***n***, where ***n*** is the entry number.
Description	Identifies a row in the Board table that is defined by this **boardEntry** block of objects. If the board is turned off using Hot Swap, the board index and values will still exist, but the Trunk MIB will not see any lines. When the board is extracted, the board index will also be removed. A board that is inserted will use the next available index number.
Configuration	Not applicable.

boardBusSegmentType

Syntax Integer

Access Read-only

OID ***p***.4.3.1.2.***n***, where ***n*** is the entry number.

Description Type of bus segment of this particular board.

Indicates the Bus type. Acceptable values are as follows:

Value	Type
1	ISA bus (not supported in Natural Access versions 4.0 and later)
2	PCI bus

Configuration None.

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boardBusSegmentNumber

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.3.***n***, where ***n*** is the entry number.
Description	Number of the bus segment in which this board is installed. Corresponds to the **busSegmentIndex** in the Bus Segment table.
Configuration	Not applicable.

boardSlotNumber

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.4.***n***, where ***n*** is the entry number.
Description	Slot of the bus segment in which the board is installed.
Configuration	Not applicable.

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boardModel

Syntax Integer

Access Read-only

OID ***p***.4.3.1.5.***n***, where ***n*** is the entry number.

Description Supported board types (for Natural Access 4.0 or later) include:

Value	Board Types
1	other
2	QX 2000/80-1L, QX 2000/80-4L, QX 2000/100-4L, QX 2000/200-4L
3	AG 2000, AG 2000 BRI, AG 2000 E&M, AG 2000 VTG, AG 2000C
4	AG Dual E1, AG Dual T1
5	AG CompactPCI Quad E1, AG CompactPCI Quad T1, AG Quad Connect E1, AG Quad Connect T1, AG Quad E1, AG Quad T1, AG QuadDual E1, AG QuadDual T1
6	AG 4000 Single E, AG 4000 Single T, AG 4000 Dual E1, AG 4000 Dual T1, AG 4000 Quad E1, AG 4000 Quad T1, AG 4000 E1, AG 4000 T1, AG 4000C Dual E1, AG 4000C Dual T1, AG 4000C Quad E1, AG 4000C Quad T1, AG 4000C E1, AG 4000C T1
7	CG 6000, CG 6000 Quad, CG 6000C Quad, CG 6100C, CG 6100C 16, CG 6100C 8
8	CX 2000-16, CX 2000-32, CX 2000C-16, CX 2000C-32, CX 2000C-48, CX 2000

For Natural Access 3.x, supported board types include:

Value	Board Type
1	other (default)
2	AG 2000
3	AG 4000 Dual T1, AG 4000C Dual T1
4	AG 4000 Quad T1, AG 4000C Quad T1
5	AG 4000 T1
6	AG-8, AG 8-80
7	AG-T1, AG-24, AG-24+
8	AG Dual T1, AG 48
9	AG Quad T1, AG Quad T1 Connect, CompactPCI AG Quad T1
10	QX 2000
11	AG 4000 Dual E1, AG 4000C Dual E1
12	AG 4000
13	AG 4000 Quad E1, AG 4000C Quad E1
14	AG-E1, AG-30
15	AG Dual E1, AG 60
16	AG Quad E1, AG Quad E1 Connect, CompactPCI AG Quad E1

Configuration Not applicable.

boardModelText

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.6.***n***, where ***n*** is the entry number.

Description Textual description of the board. Acceptable values are:

Board Type	Value
AG	AG_2000 AG_2000_BRI AG_2000_ENM AG_2000_VTG AG_2000C AG_4000_1E1 AG_4000_1T1 AG_4000_2E1 AG_4000_2T1 AG_4000_4E1 AG_4000_4T1 AG_4000_E1 AG_4000_T1 AG_4000C_2E1 AG_4000C_2T1 AG_4000C_4E1 AG_4000C_4T1 AG_4000C_E1 AG_4000C_T1 AG_Dual_E1 AG_Dual_T1 AG_CPCI_Quad_E1 AG_CPCI_Quad_T1 AG_Quad_Connect_E1 AG_Quad_Connect_T1 AG_Quad_E1, AG_Quad_T1 AG_QuadDual_E1 AG_QuadDual_T1
QX	QX 2000/80-1L QX 2000/80-4L QX 2000/100-4L QX 2000/200-4L

Board Type	Value
CG	CG_6000 CG_6000_Quad CG_6000C_Quad CG_6100C CG_6100C_16 CG_6100C_8
CX	CX 2000-16 CX 2000-32 CX 2000C-16 CX 2000C-32 CX 2000C-48 CX 2000

For Natural Access 3.x, acceptable values are:

Board Type	Value
AG	Ag24 Ag24Plus Ag30 Ag48 Ag60 Ag8 AgT1 AgE1 Ag8-80 Ag-Quad-T1 Ag-Quad-E1 Ag-Dual-T1 Ag-Dual-E1 Ag-Quad-T1-Connect Ag-Quad-E1-Connect Ag-CPCI-Quad-T1 Ag-CPCI-Quad-E1 Ag2000 Ag4000-Quad-T1 Ag4000-Quad-E1 Ag4000-Dual-T1 Ag4000-Dual-E1 Ag4000-T1 Ag4000-E1 Ag4000-Quad-T1-Connect Ag4000-Quad-E1-Connect Ag4000-Dual-T1-Connect Ag4000-Dual-E1-Connect

Board Type	Value
QX	QX-2000
N/A	Unknown

Semantics The value of this object corresponds to the textual part of the **dsx1CircuitIdentifier** object in the Trunk MIB.

Configuration Not applicable.

boardFamilyId

Syntax Integer

Access Read-only

OID ***p***.4.3.1.7.***n***, where ***n*** is the entry number.

Description Indicates the board family, as shown in the following table:

Value	Board Family
1	other (default)
2	AG/CG
3	QX
4	TX (not supported)
5	CX

Configuration Not applicable.

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boardFamilyNumber

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.8.***n***, where ***n*** is the entry number.
Description	Logical number of a board in this family. Matches the number in the *oamsys.cfg* file, and the board number in the **dsx1CircuitIdentifier** in the Trunk MIB. For Natural Access 3.x, the logical board number matches the number in the *ag.cfg* file, and the board number in the **dsx1CircuitIdentifier** in the Trunk MIB.
Configuration	Not applicable.

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boardDescr

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.9.***n***, where ***n*** is the entry number.

Description Textual description of the board (optional).

The default value is the empty string "". A sample description is:

```
Reserved for Fax Apps Only
```

The entry in the *snmp.cfg* file is:

```
BoardDesc = x, Description
```

where ***x*** = **boardFamilyNumber**.

Configuration This object is configured by editing *snmp.cfg* before starting the NMS Chassis agent.

boardStatus

Syntax Integer

Access Read-only

OID ***p***.4.3.1.10.***n***, where ***n*** is the entry number.

Description Indicates the board status as shown below:

Value	Status
1	Online.
2	Online Pending. The board coming online is in progress.
3	Failed.
4	Offline. The board is turned off, and can be extracted.
5	Offline Pending. Waiting for activity to stop (which can be time consuming).
6	Extracted.

Configuration Not applicable.

boardCommand

Syntax Integer

Access Read-write

OID ***p***.4.3.1.11.***n***, where ***n*** is the entry number.

Description Setting the value of this object turns the board on or off. You can then check the boardStatus object to see when the command has completed. Valid values are:

Value	Action
1	On (same as closing the handles in physical Hot Swap).
2	Off (same as opening the handles in physical Hot Swap).

An operation must complete (not be in the pending state) before issuing a second command.

Note: The value of this object only applies to CompactPCI boards.

Configuration Not applicable.

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boardTrunkCount

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.12.***n***, where ***n*** is the entry number.
Description	Number of trunks on this board. `0` means no trunks.
Configuration	Not applicable.

boardRevision

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.4.3.1.13.***n***, where ***n*** is the entry number.
Description	The NMS SNMP agent returns the board revision. (Not supported for Natural Access 3.x.)
Configuration	Not applicable.

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boardSerialNumber

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.4.3.1.14.***n***, where ***n*** is the entry number.
Description	The board's serial number. For example, `123456754`.
Configuration	Not applicable.

boardManufDate

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.4.3.1.15.***n***, where ***n*** is the entry number.
Description	The board's manufacturing date. For example: `week 5 00`
Configuration	Not applicable.

boardStatusLastChange

Syntax	TimeTicks
Access	Read-only
OID	***p***.4.3.1.16.***n***, where ***n*** is the entry number.
Description	The time stamp of when the status of the board last changed.
Configuration	Not applicable.

boardStatusChangeTrapEnable

Syntax Integer

Access Read-write

OID ***p***.4.3.1.17.***n***, where ***n*** is the entry number.

Description Setting this object determines whether traps should be generated for this board. Enabling this object will cause traps to be sent to the management station, and update the **boardStatusLastChange** object. Valid values are:

Value	Description
1	Enabled
2	Disabled (default)

Configuration Not applicable.

Chapter 4

Trunk MIB

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4.1 Introduction

This chapter describes the NMS Communications implementation of the Trunk MIB (RFC 2495). The organization of the tree, detailed descriptions of the nodes, and the available functions are also provided. Compliance to the Trunk MIB (RFC 2495) is also detailed.

All the boards in a chassis are represented as one managed node. Each trunk is represented by a numerical index, which is generated by sequentially numbering the trunks on all the boards.

RFC 2495 defines the near end and far end of each DS1 interface. The near end is the interface on the board that the agent is monitoring. The far end is the remote end of the trunk connected to that interface. Support is defined for the near end.

4.2 MIB Structure

The RFC 2495 MIB defines the following groups:

Group	Description
DS1 Near End Group	Contains configuration information about the DS1 interfaces, and statistics collected from the near end interface.
DS1 Far End Group	Optional and not supported.
Fractional Table	Optional and not supported.
Channel Mapping Table	Optional and not supported.
Trap Group	Enables a trap to be sent when the status of the interface changes.

4.2.1 Known Limitations

RFC 1573 defines an ifTable for all the interfaces in the system as part of MIB2. The ifTable is not accessible by the NMS SNMP agent. Therefore some portions of the RFC 2495 MIB are not supported.

The dsx1ChannelMappingTable is also not available.

The DS1 Near End Group consists of four tables:

Table	Description
Configuration	Contains information about each DS1 interface such as the number of bits per second that the circuit can reasonably carry, variety of Zero Code Suppression, and the vendor's circuit identifier.
Current	Contains statistics for the current 15-minute interval.
Interval	Contains statistics collected by each DS1 interface for the last 24 hours of operation. The past 24 hours are broken into 96 15-minute intervals. After 24 hours, the next interval pushes the oldest one out of the table.
Total	Contains the cumulative sum of the statistics for the period of time since this MIB was first started. Each field in this table contains the sum of the fields in the Current table for a particular interface.

The information in the Current table refreshes continuously. Every 15 minutes, the current table's contents are copied to the Interval table, and the sum of values from the Current table are added to the Total table. The Total table never resets, so the values are sums from the first time you started the DTM agent.

Figure 16 shows how the tables for DS1 relate:

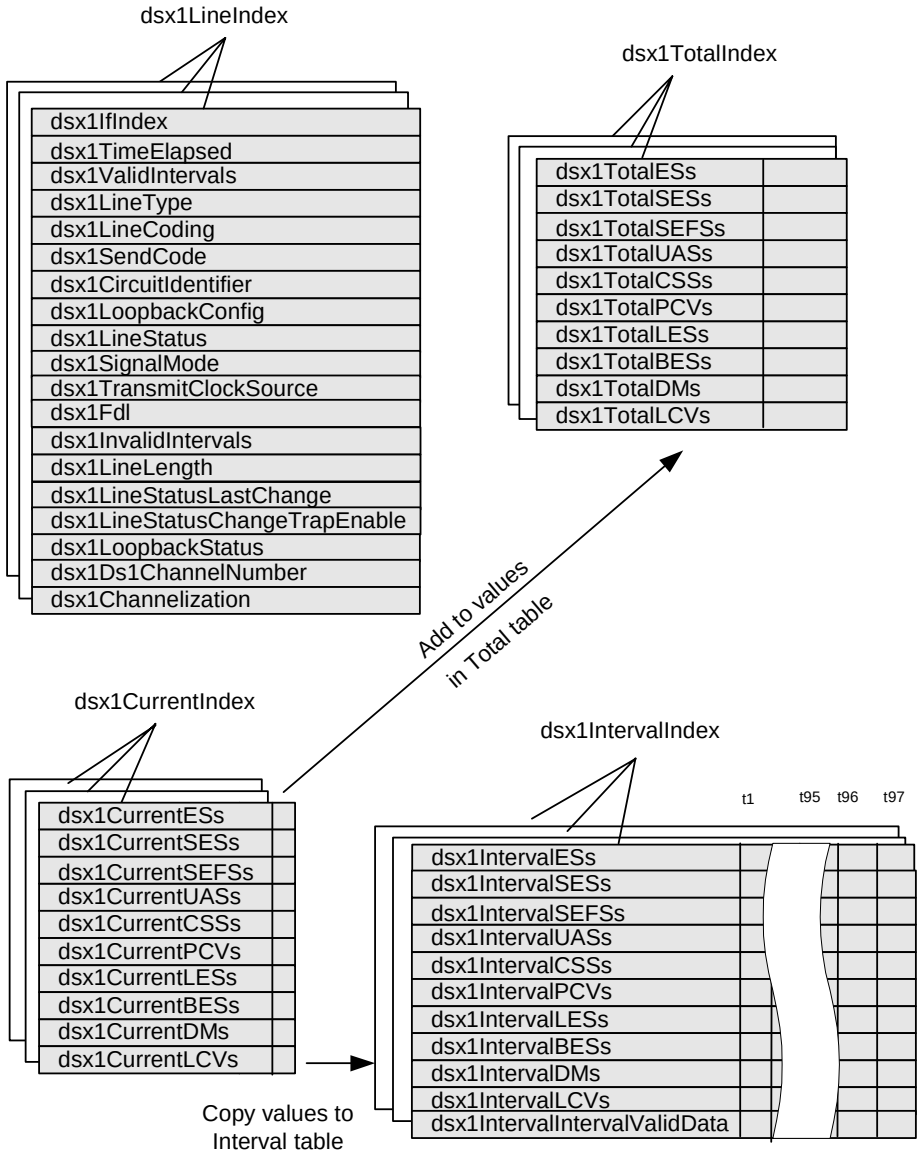

Figure 16. 2495 MIB Table Relationships

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Figure 16 shows a logical view of the tables for three DS1 interfaces. The Configuration table has an entry for each DS1 interface, which is identified by dsx1LineIndex. This index corresponds to the index in the other tables, such that all table entries with the same index number are for the same DS1 interface. Three DS1 interfaces are represented, so each table has three pages. Each column of values is started by an entry object.

Every 15 minutes, the values in the Current table are copied to the next available time slot (for example, if `t1` was filled 15 minutes ago, `t2` will be filled next) in the Interval table. The Current table values are added to the values in the Total table, which continue to add up until the agent is restarted.

If the Interval table is full when a new timeslot is added to the table, the last time slot (`t97`) is discarded, and the rest of the timeslots slide forward to make room for the new t1 timeslot.

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Figure 17 shows a tree view of the sequence of objects in the Trunk MIB:

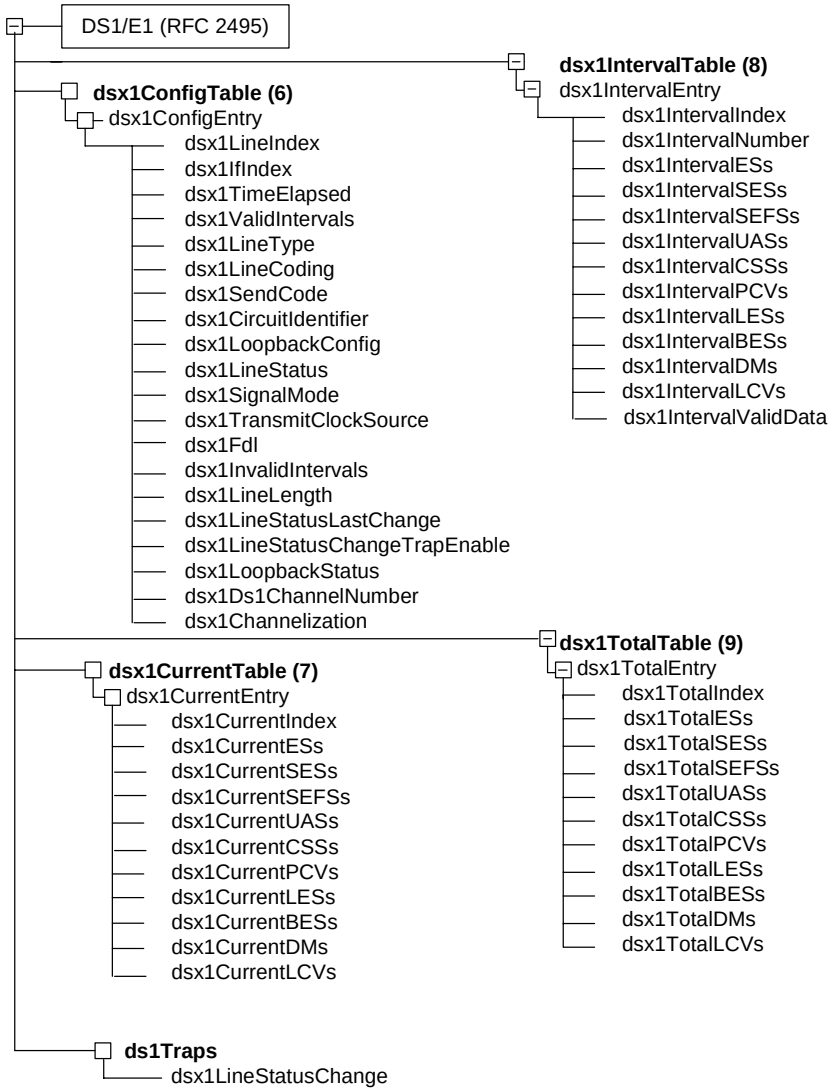

Figure 17. RFC 2495 MIB Tree

4.3 Trunk MIB Node Tables

The following sections describe the objects in this MIB. The object description includes:

Syntax	The data type of the object is shown. SNMP data types include:	
	• Integer	16-bit signed.
	• DisplayString	ASCII text.
	• Gauge	Positive integer from 0 to 4294967295 (2^{32} - 1).
	• Object	Another object type from this MIB.
	• TimeStamp	Positive integer from 0 to 4294967295 (2^{32} - 1).
	• TruthValue	Integer value where 1 is True and 2 is False.
Access	The type of access allowed for this object. Options are:	
	Read-only	This object can not be modified by SNMP.
	Read-write	You can modify this object with SNMP.
OID	Defines the path through the MIB tree to this object. All OIDs start with ***p***, where ***p*** is `1.3.6.1.2.1.10.18` (the OID for the Trunk MIB).	
Description	Describes the object.	
Configuration	Describes how to configure the object.	

The source from which the NMS MIBs was compiled is supplied with the software, in ASN1 format text files. These files can be found in *`\nms\ctaccess\doc`* (*`/opt/nms/ctaccess/doc`* under UNIX). The Trunk MIB was compiled from *`trunk-mib.txt`*. Read this file using the Windows NT Console Management function to display the SNMP information for this proprietary agent.

4.3.1 Configuration Table

The following table summarizes each object in a **dsx1ConfigEntry** block of variables:

Object	Type	Description
dsx1LineIndex	Integer	Identifies a DS1 interface in this managed node.
dsx1IfIndex	Integer	Same as dsx1LineIndex.
dsx1TimeElapsed	Integer	Time of current measurement period.
dsx1ValidIntervals	Integer	Number of 15 minute measured intervals.
dsx1LineType	Integer	Type of DS1 interface.
dsx1LineCoding	Integer	Type of Zero Code Suppression for this interface.
dsx1SendCode	Integer	Type of code in the interface.
dsx1CircuitIdentifier	DisplayString	Transmission vendor's circuit identifier.
dsx1LoopbackConfig	Integer	Loopback configuration.
dsx1LineStatus	Integer	Interface status.
dsx1SignalMode	Integer	Circuit's signal mode.
dsx1TransmitClockSource	Integer	Source of the transmit clock.
dsx1Fdl	Integer	Describes the facilities data link.

dsx1ConfigTable

Syntax	Object
Access	Not accessible
OID	***p***.6
Description	Starts a sequence of **dsx1ConfigEntry** objects, each representing a DS1 interface.
Configuration	Not applicable.

dsx1ConfigEntry

Syntax	Not applicable
Access	Not accessible
OID	***p***.6.1
Description	Starts a sequence of 13 objects that describe the configuration of the DS1 interface identified by **dsx1LineIndex**.
Configuration	Not applicable.

dsx1LineIndex

Syntax Integer (`0x1..0x7fffffff`)

Access Read-only

OID ***p***.6.1.1.***n***, where ***n*** = the index number of the DS1 interface.

Description Identifies a DS1 interface managed by this agent. The number in the index is assigned in the sequence that the agent finds the interfaces on the boards, which does not necessarily represent the physical order of the interfaces.

For Hot Swap:

If a board is...	Then the...
Extracted	Index will be removed.
Inserted	Next unused index number will be used.
Replaced	Next unused index number will be used.

Configuration Not applicable.

dsx1IfIndex

Syntax	Integer (`0x1..0x7fffffff`)
Access	Read-only
OID	***p***.6.1.2.***n***, where ***n*** = the index number of the DS1 interface.
Description	Equal to the value of **dsx1LineIndex** for boards made by NMS Communications.
Configuration	Not applicable.

dsx1TimeElapsed

Syntax	Integer (`0..899`)
Access	Read-only
OID	***p***.6.1.3.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of seconds that have elapsed since the beginning of the current error measurement period.
Configuration	Not applicable.

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dsx1ValidIntervals

Syntax	Integer (`0..96`)
Access	Read-only
OID	***p***.6.1.4.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of 15 minute intervals for which valid data was collected. The value will be 96, unless the agent has been running for less than 24 hours, in which case it will be the number of 15 minute intervals that the agent has been running minus 1 (since the time periods start with 1).
Configuration	Not applicable.

dsx1LineType

Syntax Integer

Access Read-write

OID ***p***.6.1.5.***n***, where ***n*** = the index number of the DS1 interface.

Description Type of DS1 interface implementing this circuit. Valid entries are:

Type	Value	Description
Other	1	Unlisted
dsx1ESF	2	Extended SuperFrame DS1
dsx1D4	3	AT&T D4 format DS1
dsx1E1	4	CCITT Recommendation G.704 (Table 4a)
dsx1E1-CRC	5	CCITT Recommendation G.704 (Table 4b)
dsx1E1-MF	6	G.704 (Table 4a) with TS16 multiframing enabled
dsx1E1-CRC-MF	7	G.704 (Table 4b) with TS16 multiframing enabled

Values 3 and 4 are the only options the agent can return.

For example, E1 interfaces return dsx1E1, and T1 interfaces return dsx1D4.

Configuration Not applicable.

dsx1LineCoding

Syntax Integer

Access Read-write

OID ***p***.6.1.6.***n***, where ***n*** = the index number of the DS1 interface

Description Type of Zero Code Suppression used on the interface:

Type	Value	Description
dsx1JBZS	1	Jammed Bit Zero Suppression, in which the AT&T specification of at least one pulse every 8 bit periods is implemented by forcing a pulse in bit 8 of each channel. Only seven bits per channel, or 1.344 Mbps, is available for data.
dsx1B8ZS	2	Specified pattern of normal bits and bipolar violations which replace a sequence of eight zero bits.
dsx1HDB3	3	E1 links, with or without CRC, use dsx1HDB3 or dsx1AMI.
dsx1ZBTSI	4	ANSI Clear Channels may use dsx1ZBTSI, or Zero Byte Time Slot Interchange.
dsx1AMI	5	Mode where no zero code suppression is present and the interface encoding does not solve the problem directly. In this application, the higher layer must provide data, which meets or exceeds the pulse density requirements, such as inverting HDLC data.
other	6	Unlisted (default).

Configuration This object is configured by editing the system configuration file before starting the Chassis MIB agent.

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dsx1SendCode

Syntax Integer

Access Read-write

OID ***p***.6.1.7.***n***, where ***n*** = the index number of the DS1 interface.

Description Type of code being sent across the DS1 interface by the device:

Type	Value	Description
dsx1SendNoCode	1	Sending looped or normal data.
dsx1SendLineCode	2	Sending a request for a line loopback.
dsx1SendPayloadCode	3	Sending a request for a payload loopback.
dsx1SendResetCode	4	Sending a loopback termination request.
dsx1SendQRS	5	Sending a Quasi-Random Signal(QRS) test pattern.
dsx1Send511Pattern	6	Sending a 511 bit fixed test pattern.
dsx1Send3in24Pattern	7	Sending a fixed test pattern of 3 bits set in pattern of 24.
dsx1SendOtherTestPattern	8	Sending a test pattern other than those described by this object.

Note: The SNMP agent returns dsx1SendNoCode (normal data). Loopback is not supported.

Configuration Not applicable.

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dsx1CircuitIdentifier

Syntax DisplayString (SIZE 0..255)

Access Read-write

OID ***p***.6.1.8.***n***, where ***n*** = the index number of the DS1 interface.

Description Contains the circuit identifier, which is represented by:

name-of-board_board-number_trunk-number

where:

name-of-board is one of the following:

Board Type	Value
AG	AG_Dual_E1 AG_Dual_T1 AG_Quad_E1 AG_Quad_T1 AG_Quad_Connect_E1 AG_Quad_Connect_T1 AG_CPCI_Quad_E1 AG_CPCI_Quad_T1 AG_4000_Single_E1 AG_4000_Single_T1 AG_4000_Dual_E1 AG_4000_Dual_T1 AG_4000_Quad_E1 AG_4000_Quad_T1 AG_4000C_Dual_E1 AG_4000C_Dual_T1 AG_4000C_Quad_E1 AG_4000C_Quad_T1
CG	CG_6000C_Quad

For Natural Access 3.x, acceptable values are:

Board Type	Value
AG	Ag4000-Dual-T1 Ag4000-Quad-T1 Ag4000-T1 AgT1 Ag-Dual-T1 Ag-Quad-T1-Board Ag-Quad-T1-Connect Ag4000-Dual-E1 Ag4000-E1 Ag4000-Quad-E1 AgE1 Ag-Dual-E1 Ag-Quad-E1-Board Ag-Quad-E1-Connect

board-number is a two digit number, starting at 0.

trunk-number is a two digit number, starting at 0.

For example, board 0, trunk 3, is AG_4000_Single_E1_00_03.

The circuit identifier matches the **boardModelText** object in the Chassis MIB, which allows cross referencing DS1 interfaces between the two MIBs.

Configuration Not applicable.

dsx1LoopbackConfig

Syntax Integer

Access Read-write

OID ***p***.6.1.9.***n***, where ***n*** = the index number of the DS1 interface.

Description Represents the loopback configuration of the DS1 interface. The Trunk agent will return badValue in response to a requested loopback state that the interface does not support. Valid types for RFC 2495 are:

Type	Value	Description
dsx1NoLoop	1	Not in the loopback state. A device that is not capable of performing a loopback on the interface will always return this value.
dsx1PayloadLoop	2	The received signal at this interface is looped through the device. Typically, the received signal is looped back for re-transmission after it has passed through the device's framing function.
dsx1LineLoop	3	The received signal at this interface does not go through the device.
dsx1OtherLoop	4	Loopbacks that are not defined.

Note: The agent will only return dsx1NoLoop (1). Loopback is not supported.

Configuration Not applicable.

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dsx1LineStatus

Syntax Integer (1..8191)

Access Read-only

OID ***p***.6.1.10.***n***, where ***n*** = the index number of the DS1 interface.

Description Status of the interface. It contains loopback, failure, received alarm, and transmitted alarm information. Possible status values include:

Status	Value	Description
dsx1NoAlarm	1	No Alarm Present.
dsx1RcvFarEndLOF	2	Yellow Alarm. Not supported.
dsx1XmtFarEndLOF	4	Near end sending LOF Indication. Not supported.
dsx1RcvAIS	8	Far end sending AIS (blue). Not supported.
dsx1XmtAIS	16	Near end sending AIS.
dsx1LossOfFrame	32	Near end LOF (Red Alarm).
dsx1LossOfSignal	64	Near end Loss Of Signal.
dsx1LoopbackState	128	Near end is looped.
dsx1T16AIS	256	E1 TS16 AIS.
dsx1RcvFarEndLOMF	512	Far End Sending TS16 LOMF. Not supported.
dsx1XmtFarEndLOMF	1024	Near End Sending TS16 LOMF. Not supported.
dsx1RcvTestCode	2048	Near End detects a test code.
dsx1OtherFailure	4096	Any interface status not defined.

Note: Far end is not supported.

Configuration Not applicable.

dsx1SignalMode

Syntax Integer

Access Read-write

OID ***p***.6.1.11.***n***, where ***n*** = the index number of the DS1 interface.

Description Signal mode of the circuit. Valid entries include:

Type	Value	Description
none	1	No bits are reserved for signaling on this channel.
robbedBit	2	T1 Robbed Bit Signaling is in use.
bitOriented	3	E1 Channel Associated Signaling is in use.
messageOriented	4	Common Channel Signaling is in use either on channel 16 of an E1 link or on channel 24 of a T1 link.

Configuration Not applicable.

dsx1TransmitClockSource

Syntax Integer

Access Read-write

OID ***p***.6.1.12.***n***, where ***n*** = the index number of the DS1 interface.

Description Source of the transmit clock, which the board uses for synchronization:

Type	Value	Description
loopTiming	1	The recovered receive clock of this interface is used as the transmit clock. Also know as slave.
localTiming	2	The recovered receive clock from another interface is used as the transmit clock. Also known as master.
throughTiming	3	A local clock source is used.

Configuration This object is configured by editing the system configuration before starting the Chassis MIB agent.

dsx1Fdl

Syntax Integer

Access Read-write

OID ***p***.6.1.13.***n***, where ***n*** = the index number of the DS1 interface.

Description Describes the use of the facilities data link and the sum of its capabilities. Valid entries include:

Type	Value	Description
other	1	Unknown protocol used.
dsx1Ansi-T1-403	2	FDL exchange recommended by ANSI.
dsx1Att-54016	4	ESF FDL exchanges.
dsx1Fdl-none	8	Device does not use the FDL.

Note: The NMS SNMP agent always returns dsx1Fdl - none (8). Facilities data link is not supported.

Configuration Not applicable.

dsx1InvalidIntervals

Syntax	Integer
Access	Read-only
OID	***p***.6.1.14.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of intervals with invalid data, which will always be `0` (not supported).
Configuration	Not applicable.

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dsx1LineLength

Syntax	Integer
Access	Read-write
OID	***p***.6.1.15.***n***, where ***n*** = the index number of the DS1 interface.
Description	The length of the DS1 line in meters, which will always be `0` (not supported).
Configuration	Not applicable.

dsx1StatusLastChange

Syntax	TimeStamp
Access	Read-only
OID	***p***.6.1.16.***n***, where ***n*** = the index number of the DS1 interface.
Description	Time when the status of the interface last changed.
Configuration	Not applicable.

dsx1LineStatusChangeTrapEnable

Syntax Integer

Access Read-write

OID ***p***.6.1.17.***n***, where ***n*** = the index number of the DS1 interface.

Description Determines whether traps should be generated for this interface. Possible values are:

Value	Description
1	Enabled
2	Disabled (default)

Configuration Not applicable.

dsx1LoopbackStatus

Syntax Integer (1...127)

Access Read-only

OID ***p***.6.1.18.***n***, where ***n*** = the index number of the DS1 interface.

Description Represents the current state of the loopback on the DS1 interface. It contains information about loopbacks established by a manager and remotely from the far end.

dsx1LoopbackStatus is a bit map represented as a sum; therefore, it can represent multiple loopbacks simultaneously.

The bit positions are:

Bit	Value
1	dsx1NoLoopback
2	dsx1NearEndPayloadLoopback
4	dsx1NearEndLineLoopback
8	dsx1NearEndOtherLoopback
16	dsx1NearEndInwardLoopback
32	dsx1FarEndPayloadLoopback
64	dsx1FarEndLineLoopback

Note: The NMS SNMP agent always returns dsx1NoLoopback. Loopback is not supported.

Configuration Not applicable.

dsx1Ds1ChannelNumber

Syntax	Integer (0...28)
Access	Read-only
OID	***p***.6.1.19.***n***, where ***n*** = the index number of the DS1 interface.
Description	Represents the channel number of the DS1/E1 on its parent DS2/E2 or DS3/E3. A value of `0` indicated this DS1/E1 does not have a parent DS3/E3. *Note:* The NMS SNMP agent always returns 0.
Configuration	Not applicable.

dsx1Channelization

Syntax Integer

Access Read-write

OID ***p***.6.1.20.***n***, where ***n*** = the index number of the DS1 interface.

Description Indicates whether this DS1/E1 is channelized or unchannelized. Possible values are:

Value	Description
1	disabled
2	enabledDs0
3	enabledDs1

Note: The NMS SNMP agent always returns enabledDs0. NMS boards are always channelized.

Configuration Not applicable.

4.3.2 Current Table

The following table summarizes each object in a **dsx1CurrentEntry** block of variables:

Object	Syntax	Description
dsx1CurrentIndex	Integer	Number of the DS1 interface.
dsx1CurrentESs	Gauge	Number of errored seconds.
dsx1CurrentSESs	Gauge	Number of severely errored seconds.
dsx1CurrentSEFSs	Gauge	Number of severely errored framing seconds.
dsx1CurrentUASs	Gauge	Number of unavailable seconds.
dsx1CurrentCSSs	Gauge	Number of controlled slip seconds.
dsx1CurrentPCVs	Gauge	Number of path coding violations.
dsx1CurrentLESs	Gauge	Number of interface errored seconds.
dsx1CurrentBESs	Gauge	Number of bursty errored seconds.
dsx1CurrentDMs	Gauge	Number of degraded minutes.
dsx1CurrentLCVs	Gauge	Number of line code violations.

dsx1CurrentTable

Syntax	Object
Access	Not accessible.
OID	***p***.7
Description	Starts the Current table.
Configuration	Not applicable.

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dsx1CurrentEntry

Syntax	Object
Access	Not accessible.
OID	***p***.7.1
Description	Starts a group of objects that make up a table for the DS1 interface identified by **dsx1CurrentIndex**. There is one entry object for each DS1 interface.
Configuration	Not applicable.

dsx1CurrentIndex

Syntax Integer

Access Read-only

OID ***p***.7.1.1.***n***, where ***n*** = the index number of the DS1 interface.

Description Number of the DS1 interface to which the following block of variables apply. Same as **dsx1LineIndex** in the Configuration table.

For Hot Swap:

If a board is...	Then the...
Extracted	Index will be removed.
Inserted	Next available index number will be used.
Replaced	Next available index number will be used.

Configuration Not applicable.

dsx1CurrentESs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.2.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Errored Seconds. For ESF and E1-CRC links, an Errored Second is a second with one or more Path Code Violations, OR one or more Out of Frame defects, OR one or more Controlled Slip events, OR a detected AIS defect. For D4 and E1-noCRC links, the presence of Bipolar Violations also triggers an Errored Second. This value is not incremented during an Unavailable Second.
Configuration	Not applicable.

dsx1CurrentSESs

Syntax Gauge

Access Read-only

OID ***p***.7.1.3.***n***, where ***n*** = the index number of the DS1 interface.

Description Number of Severely Errored Seconds. This value is defined differently for different signal types:

For this signal type...	A Severely Errored Second is...
ESF signals	A second with 320 or more Path Code Violation Error Events, or one or more Out of Frame defects, or a detected AIS defect.
E1-CRC signals	A second with 832 or more Path Code Violation error events, or one or more Out of Frame defects.
E1-no CRC signals	A second with 2048 Line Code Violations or more.
D4 signals	A count of one-second intervals with Framing Error events, or an OOFdefect, OR 1544 Line Code Violations or more.

Controlled slips are not included in this parameter.

This value is not incremented during an Unavailable Second.

Configuration Not applicable.

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dsx1CurrentSEFSs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.4.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Severely Errored Framing Seconds. A Severely Errored Framing Second is a second with one or more Out of Frame defects, or a detected AIS defect.
Configuration	Not applicable.

dsx1CurrentUASs

Syntax Gauge

Access Read-only

OID ***p***.7.1.5.***n***, where ***n*** = the index number of the DS1 interface.

Description Number of Unavailable Seconds.

Unavailable Seconds (UAS) are calculated by counting the number of seconds that the interface is unavailable. The DS1 interface is said to be unavailable from the onset of 10 contiguous SESs, or the onset of the condition leading to a failure. If the condition leading to the failure was immediately preceded by one or more contiguous SESs (**dsx1CurrentSESs**), then the DS1 interface unavailability starts from the onset of these SESs.

- Once unavailable, and if no failure is present, the DS1 interface becomes available at the onset of 10 contiguous seconds with no SESs.
- Once unavailable, and if a failure is present, the DS1 interface becomes available at the onset of 10 contiguous seconds with no SESs, if the failure clearing time is less than or equal to 10 seconds. If the failure clearing time is more than 10 seconds, the DS1 interface becomes available at the onset of 10 contiguous seconds with no SESs, or the onset period leading to the successful clearing condition, whichever occurs later.

All DS1 error counts are incremented while the DS1 interface is deemed available. While the interface is deemed unavailable, the only count that is incremented is UASs.

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A special case exists when the 10 or more second period crosses the 900 second statistics window boundary, because the Severely Errored Second and Unavailable Second counters must be adjusted when the Unavailable Signal State is entered. Successive **get**s of the affected dsx1IntervalSESs and dsx1IntervalUASs objects will return differing values if the first **get** occurs during the first few seconds of the window. This is an unavoidable side-effect of selecting the managed objects defined by RFC 2495.

Configuration Not applicable.

dsx1CurrentCSSs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.6.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Controlled Slip Seconds. A Controlled Slip Second is a one-second interval containing one or more controlled slips. A Controlled Slip is the replication or deletion of the payload bits of a DS1 frame. A Controlled Slip may occur when there is a difference between the timing of a synchronous receiving terminal and the received signal. A Controlled Slip does not cause an Out of Frame error.
Configuration	Not applicable.

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dsx1CurrentPCVs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.7.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Path Coding Violations. A Path Coding Violation error event is a frame synchronization bit error in the D4 and E1-noCRC formats, or a CRC or frame synch.bit error in the ESF and E1-CRC formats. Also known as CV-P (see ANSI T1.231, Section 6.5.2.1).
Configuration	Not applicable.

dsx1CurrentLESs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.8.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Line Errored Seconds. A Line Errored Second, according to T1M1.3, is a second in which one or more Line Code Violation error events were detected.
Configuration	Not applicable.

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dsx1CurrentBESs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.9.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Bursty Errored Seconds (BESs). A Bursty Errored Second (also known as Errored Second type B) is a second with fewer than 320 and more than 1 Path Coding Violation error events, no Severely Errored Frame defects and no detected incoming AIS defects. Controlled slips are not included in this parameter. This is not incremented during an Unavailable Second (**dsx1CurrentUASs**).
Configuration	Not applicable.

dsx1CurrentDMs

Syntax Gauge

Access Read-only

OID ***p***.7.1.10.***n***, where ***n*** = the index number of the DS1 interface.

Description Number of Degraded Minutes (DMs).

A Degraded Minute is one in which the estimated error rate exceeds 1E-6 but does not exceed 1E-3 (see *CCITT Specifications Volume III, Recommendation G.821*).

Degraded Minutes are determined by collecting all of the Available Seconds, removing any Severely Errored Seconds, grouping the result in 60-second long groups, and counting a 60-second long group as degraded if the cumulative errors during the seconds present in the group exceed 1E-6. Available Seconds are merely those seconds which are not Unavailable Seconds (**dsx1CurrentUASs**).

Configuration Not applicable.

dsx1CurrentLCVs

Syntax	Gauge
Access	Read-only
OID	***p***.7.1.11.***n***, where ***n*** = the index number of the DS1 interface.
Description	Number of Line Code Violations (LCVs). A Line Coding Violation (LCV) is the occurrence of either a Bipolar Violation (BPV) or Excessive Zeroes (EXZ) Error Event. Also known as CV-L. See T1.231 Section 6.5.1.1. An Excessive Zeroes error event for an AMI-coded signal is the occurrence of more than fifteen contiguous zeroes. See ANSI T1.231 Section 6.1.1.1.2. For a B8ZS coded signal, the defect occurs when more than seven contiguous zeroes are detected.
Configuration	Not applicable.

4.3.3 Interval Table

Most of the variables in the Interval table have descriptions that match a variable with a name similar to one in the Current table. For example, **dsx1IntervalESs** in the Interval table matches **dsx1CurrentESs** in the Current table. Both these variables contain the number of errored seconds for a 15 minute interval. The following table shows the matching variables from the two tables:

Current Table	Interval Table
dsx1CurrentIndex	dsx1IntervalIndex
dsx1CurrentESs	dsx1IntervalESs
dsx1CurrentSESs	dsx1IntervalSESs
dsx1CurrentSEFSs	dsx1IntervalSEFSs
dsx1CurrentUASs	dsx1IntervalUSASs
dsx1CurrentCSSs	dsx1IntervalCSSs
dsx1CurrentPCVs	dsx1IntervalPCVs
dsx1CurrentLESs	dsx1IntervalLESs
dsx1CurrentBESs	dsx1IntervalBESs
dsx1CurrentDMs	dsx1IntervalDMs
dsx1CurrentLCVs	dsx1IntervalLCVs
	dsx1IntervalNumber
	dsx1IntervalValidData

The Interval table is a doubly indexed table. For information about accessing a doubly indexed table, see Section 1.3.

There are two variables that do not match entries in the Current table: **dsx1IntervalNumber** and **dsx1IntervalValidData**. These are explained in the following sections.

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dsx1IntervalNumber

Syntax	Integer (1..96)
Access	Read-only
OID	***p***.8.1.2.***n***, where ***n*** = the index number of the DS1 interface
Description	Number of this **dsx1IntervalEntry** in the Interval table, where each block of variables covers a fifteen minute interval. There will be 96 rows in the Interval table after the DTM agent has been active for 24 hours.
Configuration	Not applicable.

dsx1IntervalValidData

Syntax	TruthValue
Access	Read-only
OID	***p***.8.1.13.***n***, where ***n*** = the index number of the DS1 interface
Description	Indicates if the data for this interval is valid (not supported).
Configuration	Not applicable.

4.3.4 Total Table

The Total table contains the sum of the statistics that the RFC 2495 MIB has kept for the managed node since the agent for this MIB first started. All the descriptions match the variables in the Current table, except that, for the Total table, the values are for the total time the MIB has been written to, and for the Current table the values are for the current 15 minute period.

The names of the variables in the two tables match, except that one starts with **dsx1Current**, and the other starts with **dsx1Total**. For example, **dsx1CurrentESs** matches **dsx1TotalESs**.

Refer to the descriptions for the Current table in Section 4.3.2 for descriptions of the Total table variables.

4.4 Trap Group

The trap group has one object, which determines whether a trap is sent when the status of the interface changes.

dsx1LineStatusChange

Syntax	TruthValue
Access	Read-only
OID	***p***.15.0.1
Description	A **dsx1LineStatusChange** trap is sent when the value of an instance **dsx1LineStatus** changes.
Configuration	Not applicable.

Chapter 5

Software Revision MIB

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5.1 Introduction

This chapter provides a detailed description of the structure and use of the NMS Software Revision MIB. Section 5.5 provides a list of managed objects contained within the NMS Software Revision MIB, ordered according to the MIB structure described in Figure 19.

5.2 Software Revision Representation

The Software Revision MIB represents all NMS software packages installed in a system. Each file in each installed software revision is tracked in the MIB. The Software Revision agent keeps the MIB up-to-date as packages are installed or removed.

Note: The agent cannot track revisions of NMS files manually copied to or deleted from a system (that is, without use of NMS installation software).

To keep the MIB up to date, the Software Revision agent relies on information from the module identification signature files (*.sgn* files) installed with each Natural Access product. These files are stored in the *\nms\bin* directory (*/opt/nms/bin* under UNIX). When the Natural Access Server (*ctdaemon*) is restarted, the Software Revision agent modifies the MIB to match the current set of signature files.

Note: Certain NMS patches do not install their *.sgn* files in the *\nms\bin* or */opt/nms/bin* directory. If the *.sgn* file is not installed in one of these directories, locate the file and manually copy it to the correct directory. The MIB cannot track a patch unless its *.sgn* file is in the correct directory.

5.3 MIB Structure

This section describes the tables in the Software Revision MIB, and the relationship between the tables.

5.3.1 Introduction

The Software Revision MIB represents a system as a single managed node that contains all packages installed within it. There are three major tables within the Software Revision MIB:

Table	Description
Package	Lists each package name and base version.
File	Lists each file in a package, and the file version.
Patch	Lists patches or service packs applied to each package.

Figure 18 shows how the tables in the Software Revision MIB are related to one another:

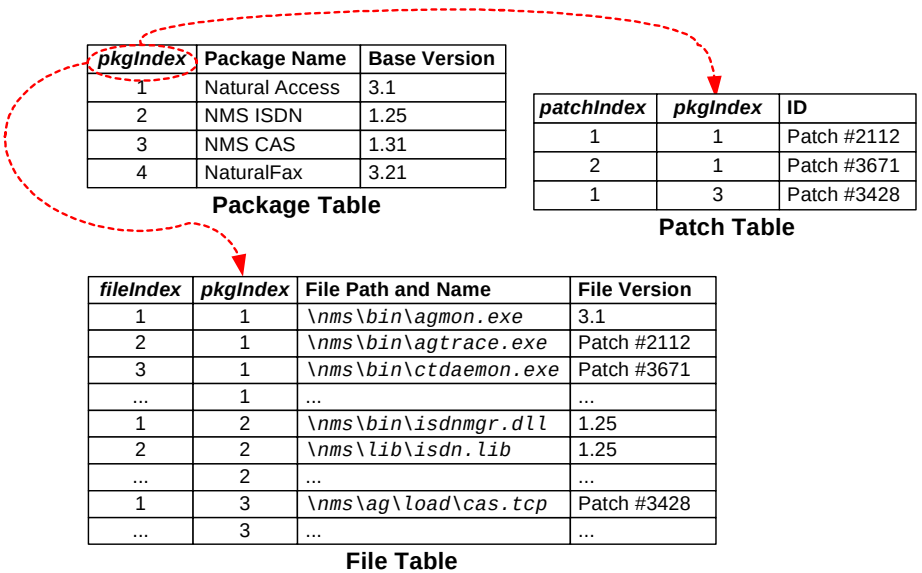

Figure 18. Software Revision MIB Table Relationships

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As shown in Figure 18, each package is identified by a unique package index ***pkgIndex***, which is assigned to it in the Package Table. In the File Table, files are listed by package index, and each file is assigned a unique file index ***fileIndex***. The file version of each file is also given here. In Figure 18, `agmon.exe`, `agtrace.exe`, and `ctdaemon.exe` are part of the Natural Access 3.1 package (***pkgIndex*** #1). Since the package was installed, `agtrace.exe` has been modified by Patch #2112, and `ctdaemon.exe` has been modified by Patch #3671.

In the Patch Table, each installed service pack and patch is listed by the ***pkgIndex*** of the package it modified. Each patch is assigned a unique patch index ***patchIndex***. In Figure 18, the Natural Access 3.1 package (***pkgIndex*** #1) has been modified twice, by Patch #2112 and Patch #3671.

The sequence of objects in the Software Revision MIB (with relative OIDs for table objects) is shown in Figure 19:

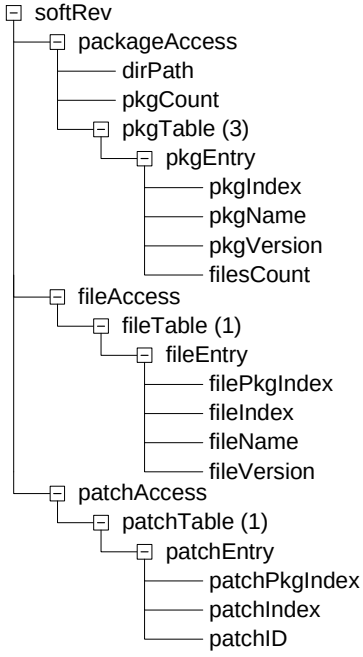

Figure 19. Software Revision MIB Objects

5.3.2 Package Table

The Package table contains the following information:

- The name of the directory where NMS packages are installed
- The total number of installed packages
- A Package Entry table containing information about each installed package, including the name of the package, the base version of the package, and the number of files in the package.

The Package table is represented in the MIB by the object **packageAccess**. The objects in the Package table are:

Object	Description
dirPath	Path where the *.sgn* files can be found.
pkgCount	Total number of installed packages.
pkgTable	Package Entry table.

The objects in the Package Entry table are:

Object	Description
pkgEntry	Top of the table.
pkgIndex	Unique identifier for an installed package.
pkgName	Name of the package.
pkgVersion	Base version of the package.
filesCount	Total number of files in the package.

As shown in Figure 18, the **pkgIndex** object provides an index into the File and Patch tables described in this chapter.

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5.3.3 File Table

The File table contains a File Entry table. This table contains a list of all files in each package. For each file, the table contains:

- The index of the package to which the file belongs
- The name of the file
- The base version of the file

The File table is represented in the MIB by the object **fileAccess**. The objects in the File table are:

Object	Description
fileTable	File Entry table.

The objects in the File Entry table are:

Object	Description
fileEntry	Top of the table.
filePkgIndex	Index of the package to which the file belongs (matches the **pkgIndex** value for the package in the Package Entry table).
fileIndex	Unique identifier for the file.
fileName	Path and filename of the file.
fileVersion	Base version of the file.

5.3.4 Patch Table

The Patch table contains a Patch Entry table. This table contains a list of all service packs or patches applied to each package. For each patch or service pack, the table contains the:

- Index of the package to which the the service pack or patch was applied
- ID of the service pack or patch

The File table is represented in the MIB by the object **patchAccess**. The objects in the Patch table are:

Object	Description
patchTable	Patch Entry table.

The objects in the Patch Entry table are:

Object	Description
patchEntry	Top of the table.
patchPkgIndex	Index of the package to which the patch was applied (matches the **pkgIndex** value for the package in the Package Entry table).
patchIndex	Unique identifier for the patch.
patchID	ID of the patch.

5.4 Using the Software Revision MIB

Once you have installed NMS packages, service packs or patches, the values in the Software Revision MIB are updated automatically when you restart the Natural Access Server (`ctdaemon`).

Note: Information in this MIB is not updated if files are added or removed manually (that is, without using NMS installation software).

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5.5 Software Revision MIB Node Tables

The following sections describe the objects in this MIB. A typical object description includes:

Syntax	The datatype of the object is shown. SNMP data types include:	
	• Integer	16-bit signed.
	• DisplayString	ASCII text.
	• Gauge	Positive integer from 0 to 4294967295 (2^{32} - 1).
	• Object	Another object type from this MIB.
	• TimeStamp	Positive integer from 0 to 4294967295 (2^{32} - 1).
Access	The type of access allowed for this object. Options are:	
	Read-only	This object can not be modified by SNMP.
	Read-write	SNMP can configure this object.
OID	The OID defines the path from the root to this object. All OIDs start with ***p***, where ***p*** is `1.3.6.1.4.1.2628.2.1` (the OID for the Software Revision MIB).	
Description	Describes the object.	
Configuration	Describes how to configure the object.	

The source from which the NMS MIBs was compiled is supplied with the software, in ASN1 format text files. These files can be found in `\nms\ctaccess\doc` (`/opt/nms/ctaccess/doc` under UNIX). The Software Revision MIB was compiled from `softrev-mib.txt`. Read this file using the Windows NT Console Management function to display the SNMP information for this proprietary agent.

packageAccess

Syntax Object

Access Not accessible.

OID ***p***.1

Description Starts a group containing the following objects:

Object	Description
dirPath	Top of the table.
pkgCount	Total number of installed packages.
pkgTable	Package Entry table.

Configuration Not applicable.

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dirPath

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.1.1
Description	The name of the directory where the NMS files are installed.
Configuration	This value is set when the first NMS package is installed.

pkgCount

Syntax	Integer
Access	Read-only
OID	***p***.1.2
Description	The total number of installed packages.
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, this value is updated to reflect the current number of installed packages.

pkgTable

Syntax Object

Access Not accessible.

OID ***p***.1.3

Description Starts a sequence of **pkgEntry** objects, each of which composes a row in the Package Entry table.

The number of **pkgEntry** objects in the table is exactly equal to **pkgCount**.

Configuration When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current set of installed packages.

pkgEntry

Syntax	Object
Access	Not accessible.
OID	***p***.1.3.1
Description	Starts a row in the Package Entry table (**pkgTable**). The number of **pkgEntry** objects in the table is exactly equal to **pkgCount**.
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current set of installed packages.

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pkgIndex

Syntax Integer

Access Read-only

OID ***p***.1.3.1.1.***n***

Description This object is the identifier of an installed package in the Package Entry (**pkgTable**) table. Each package is assigned a unique **pkgIndex** number in this table, sequentially between 1 and **pkgCount**. **pkgIndex** provides an index into the File Entry (**fileTable**) and Patch Entry (**patchTable**) tables.

Configuration This identifier is internally assigned by the agent.

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pkgName

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.1.3.1.2.***n***
Description	The name of the package.
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, all values (including this one) are imported from the `.sgn` files.

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pkgVersion

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.1.3.1.3.***n***
Description	The base version of the package.
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, all values (including this one) are imported from the `.sgn` files.

filesCount

Syntax	Integer
Access	Read-only
OID	***p***.1.3.1.4.***n***
Description	The number of files included in the package.
Configuration	This value is updated when the Natural Access Server (`ctdaemon`) is restarted.

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fileAccess

Syntax	Object
Access	Not accessible.
OID	***p***.2
Description	Starts a group containing the File Entry table (**fileEntry**).
Configuration	Not applicable.

fileTable

Syntax Object

Access Not accessible.

OID ***p***.2.1

Description Starts a sequence of **fileEntry** objects, each of which composes a row in the File Entry table. The number of **fileEntry** objects in the table is exactly equal to **filesCount**.

Configuration When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current sets of installed files.

Note: This table is not updated if files are added or removed manually (that is, without using NMS installation programs).

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fileEntry

Syntax Object

Access Not accessible.

OID ***p***.2.1.1

Description Starts a row in the File Entry table (**fileTable**). The number of **fileEntry** objects in the table is exactly equal to **filesCount**.

Configuration When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current sets of installed files.

filePkgIndex

Syntax	Integer
Access	Read-only
OID	***p***.2.1.1.1.***n***
Description	This object identifies the package to which the file belongs. It matches the **pkgIndex** identifier of an installed package in the Package Entry (**pkgTable**) table.
Configuration	This identifier is internally assigned by the agent.

fileIndex

Syntax	Integer
Access	Read-only
OID	***p***.2.1.1.2.***n***
Description	An index of a file in the package. This is a number between 1 and **filesCount**.
Configuration	This identifier is internally assigned by the agent.

fileName

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.2.1.1.3.***n***
Description	The name of the package.
Configuration	When the Natural Access Server (*ctdaemon*) is restarted, all values (including this one) are imported from the *.sgn* files.

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fileVersion

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.1.1.4.***n***

Description The base version of the package.

This value will contain a checksum error if the file has been manually modified or corrupted since it was installed by NMS software.

Configuration When the Natural Access Server (`ctdaemon`) is restarted, all values (including this one) are imported from the `.sgn` files.

patchAccess

Syntax	Object
Access	Not accessible.
OID	***p***.3
Description	Starts a group containing the Patch Entry table (**patchEntry**).
Configuration	Not applicable.

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patchTable

Syntax	Object
Access	Not accessible.
OID	***p***.3.1
Description	Starts a sequence of **patchEntry** objects, each of which composes a row in the Patch Entry table.
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current sets of installed patches and service packs.

patchEntry

Syntax	Object
Access	Not accessible.
OID	***p***.3.1.1
Description	Starts a row in the Patch Entry table (**patchEntry**).
Configuration	When the Natural Access Server (`ctdaemon`) is restarted, rows are added or removed as necessary to reflect the current sets of installed patches and service packs.

patchPkgIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.1.***n***
Description	This object identifies the package to which the service pack or patch was applied. It matches the **pkgIndex** identifier of an installed package in the Package Entry (**pkgTable**) table.
Configuration	This identifier is internally assigned by the agent.

patchIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.2.***n***
Description	An index of a service pack or patch in the table.
Configuration	This identifier is internally assigned by the agent.

patchID

Syntax	DisplayString (SIZE 0..255)
Access	Read-only
OID	***p***.3.1.1.3.***n***
Description	The ID or number of the patch.
Configuration	When the Natural Access Server (*ctdaemon*) is restarted, all values (including this one) are imported from the *.sgn* files.

Chapter 6

OAM Database MIB

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6.1 Introduction

This chapter provides a detailed description of the structure and use of the NMS OAM Database MIB. Section 6.4 provides a list of managed objects contained within the NMS OAM Database MIB, ordered according to the MIB structure described in Figure 22.

For detailed information on NMS OAM, refer to the *NMS OAM System User's Manual* and to the *NMS OAM Service Developer's Reference Manual*.

6.2 OAM Database Representation

The OAM Database MIB presents an SNMP front end to the contents of the NMS OAM database on a system. Within this database, NMS OAM software maintains tables of configuration data for hardware and software components in the system. Each table of configuration data constitutes a *managed object*: the logical representation of the component to the system. Using the OAM Database MIB, you can query, add, modify, or delete information for managed objects in much the same way as NMS OAM does.

6.2.1 Managed Components

NMS OAM manages the following components (see Figure 20):

- Boards

  A separate set of configuration information is kept for each AG, CG, CX, and QX board in the system.

- NMS OAM Supervisor

  NMS OAM keeps configuration information for its Supervisor process, which oversees all other NMS OAM components.

- Board plug-ins

  NMS OAM communicates with boards using software extensions called board plug-ins. There is one plug-in per board family. NMS OAM maintains a separate set of configuration information for each plug-in.

- Extended management components (EMCs)

  Extended management components (EMCs) are software modules which add functionality to NMS OAM. A separate set of configuration data is kept for each EMC. Currently, two EMCs are supplied with NMS OAM:

  - *Hot Swap* EMC
  - H.100 and H.110 *Clock Management* EMC

Figure 20 illustrates the relationship between the components in a system, their representation as managed objects within NMS OAM, and the relationship of managed objects to data within the NMS OAM database:

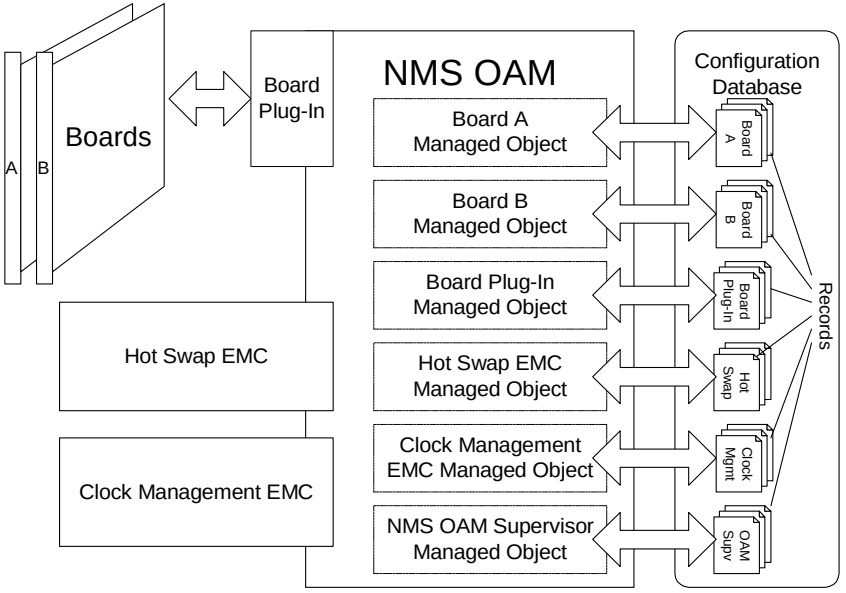

Figure 20. NMS OAM Components and Managed Objects

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6.2.2 OAM Database MIB

Within the OAM Database MIB, the data in the NMS OAM database is represented in the following tables:

Table	Contains
oamSupervisor	A table allowing access to the configuration data for the Supervisor managed object. Additional values in this table allow an application to: • Start and stop the Supervisor process • Set up event masking • Configure alert registration • Create new board entries
oamBoardPlugins	A table allowing access to the configuration data for each installed board plug-in.
oamEMCs	A table allowing access to the configuration data for each installed EMC.
oamBoards	Tables allowing access to the configuration data for each board in the system. These tables allow an application to: • Query and change keywords for managed objects • Query and change board names and numbers • Start and stop a board • Test a board • Delete a board configuration from the database
oamOtherObjects	Contains a table allowing access to the configuration data for other managed objects (if any).
oamEventsTraps	Allows you to examine incoming NMS OAM events.

Figure 21 illustrates the relationship between the NMS OAM database and SNMP MIBs:

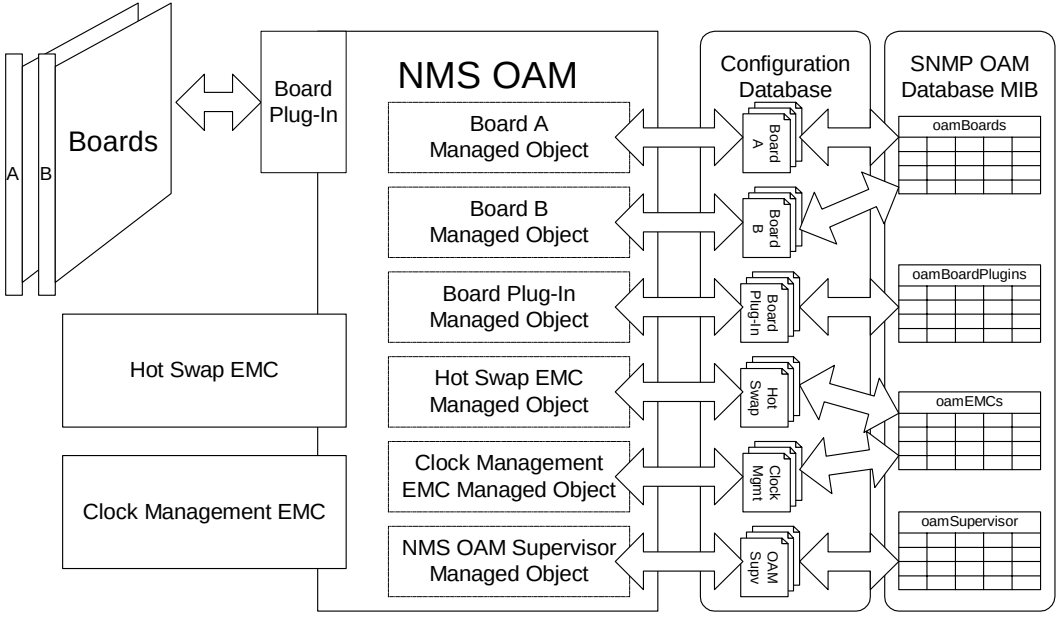

Figure 21. NMS OAM Database and SNMP MIB Tables

6.2.3 Keywords in the OAM Database MIB

Configuration data in both the NMS OAM database and the OAM database MIB is expressed as keyword name/value pairs (for example, `AutoStart = YES`). Keywords and values can be queried, added, modified, or deleted. Modifying a keyword in the MIB modifies the keyword in the NMS OAM database, and vice versa.

Each keyword has several attributes, called *qualifiers*. For example, the qualifier Type indicates the type of value it accepts (Integer, String, etc.). The qualifier ReadOnly indicates if a keyword is read-only. Within the OAM database MIB, qualifier information for each keyword is stored with the keyword.

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The following table lists the information stored in a MIB for each keyword:

Datum	Description	Valid Values
Managed Object Index	The index of the managed object to which the keyword belongs.	Any integer from 1 upward.
Index	A unique (within the table) index for the keyword.	Any integer from 1 upward.
Keyword Name	The name of the keyword.	The keyword name, preceded by one or more group keyword names separated by periods (see below).
Keyword Value	The value of the keyword.	Any value permitted by the keyword's type and possible value parameters.
Type	Type of keyword value. Equivalent to the value of the keyword's Type qualifier.	`Integer`, `String`, or `Object`. Keywords of type `Object` appear only in the Supervisor Keyword table (**supervisorTable**).
Mode	Indicates if keyword value is read-only or not. Reflects the value of the keyword's Readonly qualifier.	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
Possible Values	Indicates the range of possible values for the keyword. Combines information from the keyword's Base, Min, Max, and Choices qualifiers.	If the keyword type is Integer, and is a yes/no choice, this field contains a string of this format: `Nb values=2: Yes,No` If the keyword type is Integer, and can take a range of values, this field contains a string of this format: BASE ***base*:*min_value*** `<>` ***max_value*** ...where: • ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number). • ***min_value*** is the minimum allowed value. • ***max_value*** is the maximum allowed value. For example: `BASE 10: 0 <> 65535` If the keyword type is String, this field contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`. If the keyword type is Object, no possible values are given.
Description	Text describing the keyword. Equivalent to the value of the keyword's Description qualifier.	A string of text. If no description is given, this keyword contains `<none>`.

Within NMS OAM, keywords are grouped into a variety of formats which allow an application to enumerate keyword sets to determine their values. These formats include arrays, structs, structs containing arrays, arrays containing structs and so forth. Each group of keywords is represented by a keyword that does not actually contain configuration data, but instead merely represents the group.

Within the OAM database MIB, keyword enumeration takes place transparently. Thus there is no need to include group name keywords as separate entries in the MIB. Instead, only keywords that actually contain values (that is, keywords of type Integer or String) are given separate entries in the tables. Where a keyword belongs to one or more groups, the group names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

6.2.4 Populating the Tables

When the OAM Database SNMP agent is launched, it opens the NMS OAM Supervisor managed object. It populates the OAM Database MIB tables based on information it finds in this managed object, and in objects referenced in this object.

For each Integer or String keyword in the NMS OAM Supervisor managed object, the agent creates a row in the Supervisor Keyword table (**supervisorTable**), and stores the keyword and qualifier information as described in Section 6.2.3. It also uses some of the Supervisor keywords to access the board plug-ins, EMCs, and board managed objects, so it can populate the other tables in the MIB. This operation is described in greater detail in the table sections below.

The sequence of objects in the OAM Database MIB (with relative OIDs for table objects) is shown in Figure 22:

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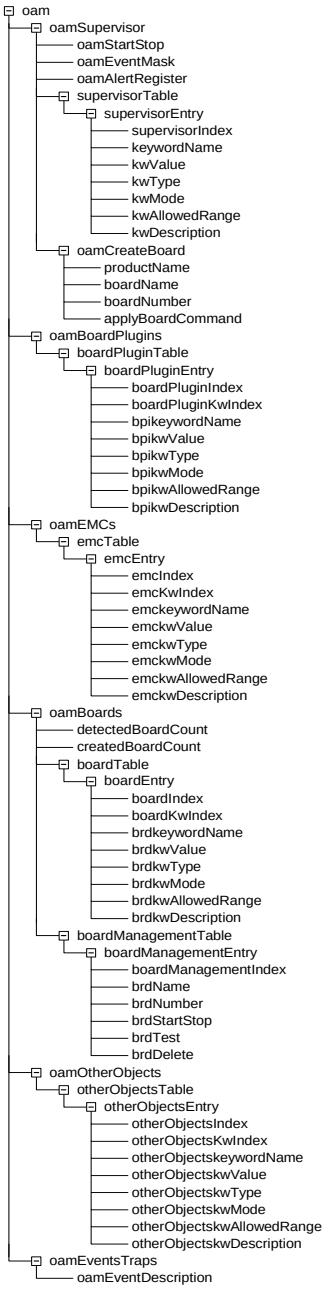

Figure 22. OAM Database MIB Objects

6.2.5 OAM Supervisor Tables

The OAM Supervisor table contains

- A table of Supervisor keywords, values, and qualifiers
- Values that allow you to start or stop the Supervisor process, set up event masks, register for NMS OAM alert events, and create board instances in the database

The objects in the OAM Supervisor table (**oamSupervisor**) are:

Object	Description
oamStartStop	Starts or stops the NMS OAM Supervisor process, or indicates its status.
oamEventMask	Sets the NMS OAM event mask, or indicates its status.
oamAlertRegister	Registers for NMS OAM alert notification, or indicates the status of the registration.
supervisorTable	Supervisor Keyword table, containing NMS OAM Supervisor keywords, values, and qualifiers.
oamCreateBoard	Create Board table, containing values that allow you to create board instances in the database.

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The objects in the Supervisor Keyword table (**supervisorTable**) are:

Object	Description
supervisorTable	Top of the table.
supervisorEntry	Starts a row of the Supervisor Keyword table.
supervisorIndex	Unique index (within this table) identifying the keyword.
keywordName	The keyword name, formatted as described in Section 6.2.3.
kwValue	The value of the keyword.
kwType	The type of the keyword: `Integer`, `String`, or `Object`
kwMode	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
kwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
kwDescription	A short description of the keyword.

Figure 23 shows sample HPOpenView output displaying the contents of the Supervisor Keyword table:

	supervisorIndex	keywordName	kwValue	kwType	kwMode	kwAllowedRang	kwDescription
1	1	ExtendedManagementComponents[0]	clkmgr.emc	Object	readOnly	<no range>	<none>
2	2	ExtendedManagementComponents[1]	HotSwap.emc	Object	readOnly	<no range>	<none>
3	3	Products[0]	AG_2000	String	readOnly	<no range>	<none>
4	4	Products[1]	AG_4000_1E1	String	readOnly	<no range>	<none>
5	5	Products[2]	AG_4000_1T1	String	readOnly	<no range>	<none>
6	6	Products[3]	AG_4000_2E1	String	readOnly	<no range>	<none>
7	7	Products[4]	AG_4000_2T1	String	readOnly	<no range>	<none>
8	8	Products[5]	AG_4000_4E1	String	readOnly	<no range>	<none>
9	9	Products[6]	AG_4000_4T1	String	readOnly	<no range>	<none>
10	10	Products[7]	AG_4000C_2E1	String	readOnly	<no range>	<none>
11	11	Products[8]	AG_4000C_2T1	String	readOnly	<no range>	<none>
12	12	Products[9]	AG_4000C_4E1	String	readOnly	<no range>	<none>
13	13	Products[10]	AG_4000C_4T1	String	readOnly	<no range>	<none>
14	14	Products[11]	AG_CPCI_Quad_E1	String	readOnly	<no range>	<none>
15	15	Products[12]	AG_CPCI_Quad_T1	String	readOnly	<no range>	<none>
16	16	Products[13]	AG_Dual_E1	String	readOnly	<no range>	<none>
17	17	Products[14]	AG_Dual_T1	String	readOnly	<no range>	<none>
18	18	Products[15]	AG_Quad_Connect_E1	String	readOnly	<no range>	<none>
19	19	Products[16]	AG_Quad_Connect_T1	String	readOnly	<no range>	<none>
20	20	Products[17]	AG_Quad_E1	String	readOnly	<no range>	<none>
21	21	Products[18]	AG_Quad_T1	String	readOnly	<no range>	<none>
22	22	Products[19]	CG_6000C_Quad	String	readOnly	<no range>	<none>
23	23	Products[20]	CX 2000-16	String	readOnly	<no range>	<none>
24	24	Products[21]	CX 2000-32	String	readOnly	<no range>	<none>
25	25	Products[22]	CX 2000C-16	String	readOnly	<no range>	<none>
26	26	Products[23]	CX 2000C-32	String	readOnly	<no range>	<none>
27	27	Products[24]	CX 2000C-48	String	readOnly	<no range>	<none>
28	28	Products[25]	QX 2000/100-4L	String	readOnly	<no range>	<none>
29	29	Products[26]	QX 2000/200-4L	String	readOnly	<no range>	<none>
30	30	Products[27]	QX 2000/80-1L	String	readOnly	<no range>	<none>
31	31	Products[28]	QX 2000/80-4L	String	readOnly	<no range>	<none>
32	32	BoardPlugins[0]	agplugin.bpi	Object	readOnly	<no range>	<none>
33	33	BoardPlugins[1]	cg6kpi.bpi	Object	readOnly	<no range>	<none>
34	34	BoardPlugins[2]	cx.bpi	Object	readOnly	<no range>	<none>
35	35	BoardPlugins[3]	qx2kpi.bpi	Object	readOnly	<no range>	<none>
36	36	Boards[0]	Name0	Object	readOnly	<no range>	<none>
37	37	Boards[1]	Name1	Object	readOnly	<no range>	<none>
38	38	Name	Supervisor	Object	readOnly	<no range>	<none>

Figure 23. HPOpenView Output

The objects in the Create Board table (**oamCreateBoard**) are:

Object	Description
productName	Product type of the board to create. *Note:* All product names supported by NMS OAM can be found in the Supervisor keyword `Products[x]`. To learn how to access this keyword in the MIB, see Section 6.3.1.
boardName	Name to give the created board.
boardNumber	Board number to give the created board.
applyBoardCommand	Set this to 1 to create the board based upon the **productName**, **boardName**, and/or **boardNumber** values you specified.

6.2.6 OAM Board Plug-in Table

The OAM Board Plug-in table contains, for each board plug-in, a table of the plug-in's keywords, values, and qualifiers.

The objects in the OAM Board Plug-in table (**oamBoardPlugins**) are:

Object	Description
boardPluginTable	Top of the table.
boardPluginEntry	Starts a row of the OAM Board Plug-in table.
boardPluginIndex	Plug-in index. This is equivalent to the index number of the `BoardPlugins[x]` keyword listing the board plug-in in the Supervisor managed object (see below).
boardPluginKwIndex	Unique index (within this table) identifying the keyword.
bpikeywordName	The keyword name, formatted as described in Section 6.2.3.
bpikwValue	The value of the keyword.
bpikwType	The type of the keyword: `Integer` or `String`.
bpikwMode	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
bpikwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
bpikwDescription	A short description of the keyword.

To populate this table, the OAM Database SNMP agent opens the NMS OAM Supervisor managed object, and retrieves the values in `BoardPlugins[x]` keyword. This is an array listing the board plug-ins installed and running under the Supervisor. The agent opens the managed object for each listed plug-in, and creates a row in the Board Plug-in table (**oamBoardPlugins**) for each keyword in the managed object. Each keyword is given two indices:

- The index of the plug-in to which the keyword belongs (**boardPluginIndex**). This is equivalent to the index of the `BoardPlugins[x]` keyword listing the managed object.
- A unique numerical index (**boardPluginKwIndex**), from 1 upwards.

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6.2.7 Extended Management Component (EMC) Table

The Extended Management Component (EMC) table contains, for each EMC, a table of the EMC's keywords, values and qualifiers.

The objects in the Extended Management Component (EMC) table (**oamEMCs**) are:

Object	Description
emcTable	Top of the table.
emcEntry	Starts a row of the Extended Management Component table.
emcIndex	EMC index.
emcKwIndex	Unique index (within this table) identifying the keyword.
emckeywordName	The keyword name, formatted as described in Section 6.2.3.
emckwValue	The value of the keyword.
emckwType	The type of the keyword: `Integer` or `String`.
emckwMode	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
emckwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
emckwDescription	A short description of the keyword.

To populate this table, the OAM Database SNMP agent opens the NMS OAM Supervisor managed object, and retrieves the values in the `ExtendedManagementComponents[x]` keyword. This is an array listing the EMCs installed and running under the Supervisor. The agent opens the managed object for each listed EMC, and creates a row in the Extended Management Object table (**oamEMCs**) for each keyword in the managed object. Each keyword is given two indices:

- The index of the EMC to which the keyword belongs (**emcIndex**). This is equivalent to the index of the `ExtendedManagementComponents[x]` keyword listing the managed object.
- A unique numerical index (**emcKwIndex**), from 1 upwards.

6.2.8 OAM Boards Table

The OAM Boards table contains

- The number of boards automatically detected in the system
- The total number of boards registered to NMS OAM
- A table of boards, each with their keywords, values and qualifiers
- Values that allow you to start or stop a board, test a board, or delete a board instance from the database

The objects in the OAM Boards table (**oamBoards**) are:

Object	Description
detectedBoardCount	The number of boards automatically detected in the system.
createdBoardCount	The total number of boards registered to NMS OAM.
boardTable	Board Keyword table, containing a list of boards, each with their keywords, values, and qualifiers.
boardManagementTable	Board Management table, containing values that allow you to start, stop, test, or delete a board, change the board name or number, or query its status.

The objects in the Board Keyword table (**boardTable**) are:

Object	Description
boardTable	Top of the table.
boardEntry	Starts a row of the Board Keyword table.
boardIndex	Board index.
boardKwIndex	Unique index (within this table) identifying the keyword.
brdkeywordName	The keyword name, formatted as described in Section 6.2.3.
brdkwValue	The value of the keyword.
brdkwType	The type of the keyword: `Integer` or `String`.
brdkwMode	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
brdkwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
brdkwDescription	A short description of the keyword.

To populate the Board Keyword table (**boardTable**), the OAM Database SNMP agent opens the NMS OAM Supervisor managed object, and retrieves the values in `Boards[x]` keyword. This is an array listing the boards managed by the board plug-ins running under the Supervisor. The agent opens the managed object for each listed board, and creates a row in the Board Keyword table for each keyword in the managed object. Each keyword is given two indices:

- The index of the board to which the keyword belongs (**boardIndex**). This is equivalent to the index of the `Boards[x]` keyword listing the managed object.

  Note: This index does not necessarily match the board number (the value of the `Number` keyword for the board).

- A unique numerical index (**boardKwIndex**), from 1 upwards.

The objects in the Board Management table (**boardManagementTable**) are:

Object	Description
boardManagementEntry	Top of the table.
boardManagementIndex	Index of the board to manage (matches the **boardIndex** of the board in the Board Keywords table).
brdName	Use to query or change the board name.
brdNumber	Use to query or change the board number.
brdStartStop	Starts or stops the board, or indicates its status.
brdTest	Tests the board, or indicates the testing status.
brdDelete	Delete the board instance from the NMS OAM database.

6.2.9 Other Objects Table

The Other Objects table is included so that future extensions to NMS OAM do not require changes to the structure of the OAM Database MIB. The Other Objects table will contain, for each object, a table of the objects keywords, values and qualifiers.

The objects in the Other Objects table (**oamOtherObjects**) are:

Object	Description
otherObjectsTable	Top of the table.
otherObjectsEntry	Starts a row of the Other Objects table.
otherObjectsIndex	Object index.
otherObjectsKwIndex	Unique index (within this table) identifying the keyword.
otherObjectskeywordName	The keyword name, formatted as described in Section 6.2.3.
otherObjectskwValue	The value of the keyword.
otherObjectskwType	The type of the keyword: `Integer` or `String`.
otherObjectskwMode	`1` indicates keyword value is read-only. `2` indicates keyword value is read/write.
otherObjectskwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
otherObjectskwDescription	A short description of the keyword.

6.2.10 OAM Events Traps Table

The OAM Events Traps table allows an application to receive OAM events through the MIB. The objects in the OAM Events Traps table (**oamEventsTraps**) are:

Object	Description
oamEventDescription	The last event sent back by OAM.

6.3 Using the OAM Database MIB

This section describes how to use the values in the OAM Database MIB and provides other information common to more than one table.

6.3.1 Accessing Keywords for Boards, Plug-ins, or EMCs

To access a particular keyword for a board, a board plug-in, or an EMC:

1. Determine the index of the managed object containing the keyword. To do so, access the Supervisor Keyword table (**supervisorTable**), and search for the managed object name in one of the following array keywords:

For this managed object...	Search this array...
Board	`Boards[x]`
Board Plug-in	`BoardPlugins[x]`
EMC	`ExtendedManagementComponents[x]`

2. Access the table containing keywords for the managed object type:

For this managed object...	Access this table...
Board	**boardTable**
Board Plug-in	**boardPluginTable**
EMC	**emcTable**

   Each of these tables is doubly linked. The first index, the managed object index, maps to the index you determined in step 1.

3. Within the entries in the table beginning with the desired index, search for the keyword.

To set a keyword, first determine that it is read/write. If it is, make sure the type (for example, integer or string) of your setting is correct for the keyword, and is within the range of allowed values.

Board settings do not take effect until the board is stopped and restarted.

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6.3.2 Creating Board Managed Objects

You can use the items in the Create Board table (**oamCreateBoard**) to add a board managed object to the NMS OAM database. To do so:

Note: This operation does not require that the board currently be physically installed in the system.

1. Specify a valid product name for **productName**. A list of valid product names can be retrieved by querying the Supervisor keyword `Products[x]`.
2. (Optional) Specify a board name for **boardName**.
3. (Optional) Specify a board number for **boardNumber**.
4. Set **applyBoardCommand** to 1.

   A board managed object for product **productName** is added to the NMS OAM database. If you did not specify a board name or number, default values are generated.
5. Access and modify the board's keywords (as described in Section 6.3.1) to perform further configuration. In particular, modify the `Location.PCI.Bus` and `Location.PCI.Slot` keywords to specify the location of the board for NMS OAM.
6. If the board is physically installed in the system, start the board, as described in Section 6.3.5.

6.3.3 Querying or Setting the Name of a Board

For a board to be available, it must exist as a managed object in the NMS OAM database.

To set or query the name of a board:

1. Determine the index of the board managed object.

   To do so, access the Supervisor Keyword table (**supervisorTable**), and search for the board name in the `Boards[x]` array keyword. The index of the board name in the array maps to the index of the board managed object.
2. Find the **boardManagementIndex** with the index value.

3. To set the name of the board, set **brdName** in this row to the new name. To query the board's name, query **brdName**.

6.3.4 Querying or Setting the Board Number of a Board

For a board to be available, it must exist as a managed object in the NMS OAM database.

To set or query the board number of a board:

1. Determine the index of the board managed object.

   To do so, access the Supervisor Keyword table (**supervisorTable**), and search for the board name in the `Boards[x]` array keyword. The index of the board name in the array maps to the index of the board managed object.

2. Find the **boardManagementIndex** with the index value.

3. To set the board number of the board, set **brdNumber** in this row to the new board number. To query the board's number, query **brdNumber**.

6.3.5 Starting or Stopping Boards

For a board to be available for starting, it must exist as a managed object in the NMS OAM database.

To start or stop a board, or query its status:

1. Determine the index of the board managed object.

   To do so, access the Supervisor Keyword table (**supervisorTable**), and search for the board name in the `Boards[x]` array keyword. The index of the board name in the array maps to the index of the board managed object.

2. Find the **boardManagementIndex** with the index value.

3. To start the board, set **brdStartStop** in this row to `1`. To stop the board, set **brdStartStop** in this row to `2`. To query the status of the board, query **brdStartStop**.

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6.3.6 Testing Boards

For a board to be available for testing, it must exist as a managed object in the NMS OAM database.

To test a board:

1. Determine the index of the board managed object.

   To do so, access the Supervisor Keyword table (**supervisorTable**), and search for the board name in the `Boards[x]` array keyword. The index of the board name in the array maps to the index of the board managed object.

2. Find the **boardManagementIndex** with the index value.

3. Set **brdTest** in this row to the board test level you wish to run (an integer between `1` and `255`). For more information about board testing, refer to the *NMS OAM System User's Manual*.

6.3.7 Deleting Board Managed Objects

To delete a board managed object:

1. Stop the board as described in Section 6.3.5.

2. Find the **boardManagementIndex** with the index value of the managed object for the board.

3. Set **brdDelete** in this row to `1`.

6.3.8 Starting and Stopping the Supervisor

You can stop and restart the NMS OAM Supervisor using the OAM Database MIB.

- To stop the Supervisor, set **oamStartStop** to `2`.
- To start the Supervisor, set **oamStartStop** to `1`.

You can determine the current status (stopped or running) of the Supervisor by querying **oamStartStop**.

Note: If you query this keyword while the Supervisor is in the process of shutting down, the keyword indicates that the Supervisor is running.

6.3.9 Events

NMS OAM events (both solicited and unsolicited) are available via SNMP. An SNMP application can receive them either as SNMP traps, or by querying the OAM database MIB.

To receive NMS OAM events as SNMP traps, set **oamAlertRegister** to 1. To stop receiving events as traps, set **oamAlertRegister** to 2.

Regardless of whether SNMP is registered to receive NMS OAM events, an application can always determine the last event received by querying **oamEventDescription**. This value contains a string of the form:

eventname `name=`***objectname***

... where:

- ***eventname*** is the name of the last event received (for example: `OAMEVN_STARTBOARD_DONE`).
- ***objectname*** is the name of the object sending the event (for example: `MyBoard`).

For example: `OAMEVN_STARTBOARD_DONE name=MyBoard`

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The events in the following table are reported slightly differently in **oamEventDescription**:

Event Name	String in oamEventDescription
OAMEVN_ALERT	***eventname*** `name=`***objectname*** `message=`***message*** ***message*** is the alert message sent
OAMEVN_REPORT	***eventname*** `name=`***objectname*** `message=`***message*** ***message*** is the alert message sent
OAMEVN_TRACE	***eventname*** `name=`***objectname*** `message=`***message*** ***message*** is the alert message sent
OAMEVN_RENAMED	***eventname*** `oldname=`***oldname*** `newname=`***newname*** ***oldname*** is the original name of the board. ***newname*** is the new name of the board

You can mask the alerts received by SNMP (either as traps or by querying the MIB) by setting **oamEventMask**. The following are valid mask values:

Mask	Value	Description
TRAP_MASK_OAMEVN_ALERT	0x1	An OAM alert has been generated
TRAP_MASK_OAMEVN_REPORT	0x2	Special internal code used to log report info
TRAP_MASK_OAMEVN_CREATED	0x4	Object was created
TRAP_MASK_OAMEVN_DELETED	0x8	Object was deleted
TRAP_MASK_OAMEVN_RENAMED	0x10	Object was renamed (text = new name)
TRAP_MASK_OAMEVN_TRACE	0x20	Indicates trace info (potentially high-speed)
TRAP_MASK_OAMEVN_MODIFIED	0x40	Object was modified (closed after write access)
TRAP_MASK_OAMEVN_BOARD_DEAD	0x80	A board has failed
TRAP_MASK_OAMEVN_STARTBOARD_DONE	0x100	A board was successfully started

Mask	Value	Description
TRAP_MASK_OAMEVN_STOPBOARD_DONE	0x200	A board was successfully stopped
TRAP_MASK_OAMEVN_TESTBOARD_DONE	0x400	A board test was successfully initiated
TRAP_MASK_HSWEVN_REMOVAL_REQUESTED	0x800	A board extraction has begun, or board extraction was initiated in software
TRAP_MASK_HSWEVN_BOARD_OFFLINE	0x1000	A board has gone off line
TRAP_MASK_HSWEVN_BOARD_REMOVED	0x2000	A board has been removed
TRAP_MASK_HSWEVN_BOARD_INSERTED	0x4000	A board has been inserted
TRAP_MASK_HSWEVN_ONLINE_PENDING	0x8000	A board has been inserted, and is about to go online
TRAP_MASK_HSWEVN_PCI_CONFIG_FAILED	0x10000	A PCI configuration attempt failed
TRAP_MASK_HSWEVN_PREPARATION_FAILED	0x20000	Preparation for board removal failed
TRAP_MASK_HSWEVN_BOARD_READY	0x40000	A board is ready

By default, no masks are set.

For more information on OAM events, refer to your *OAM Service Developer's Reference Manual*.

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6.4 Node Tables

The following sections describe the objects in this MIB. A typical object description includes:

Managed Object		
Syntax	The datatype of the object is shown. SNMP data types include:	
	• Integer	16-bit signed.
	• DisplayString	ASCII text.
	• Gauge	Positive integer from 0 to 4294967295 (2^{32} - 1).
	• Object	Another object type from this MIB.
	• TimeStamp	Positive integer from 0 to 4294967295 (2^{32} - 1).
Access	The type of access allowed for this object. Options are:	
	Read-only	This object can not be modified by SNMP.
	Read-write	SNMP can configure this object.
OID	The OID defines the path from the root to this object. All OIDs start with ***p***, where ***p*** is is `1.3.6.1.4.1.2628.3.1` (the OID for the OAM Database MIB).	
Description	Describes the object.	
Configuration	Describes how to configure the object.	

The source from which the NMS MIBs was compiled is supplied with the software, in ASN1 format text files. These files can be found in `\nms\ctaccess\doc` (`/opt/nms/ctaccess/doc` under UNIX). The OAM Database MIB was compiled from `oamdatabase-mib.txt`. Read this file using the NT Console Management function to display the SNMP information for this proprietary agent.

oamSupervisor

Syntax Object

Access Not accessible.

OID ***p***.1

Description Starts a group containing the following objects:

Object	Description
oamStartStop	Starts or stops the NMS OAM Supervisor process, or indicates its status.
oamEventMask	Sets the NMS OAM event mask, or indicates its status.
oamAlertRegister	Registers for NMS OAM alert notification, or indicates the status of the registration.
supervisorTable	Supervisor Keyword table, containing NMS OAM Supervisor keywords, values and qualifiers.
oamCreateBoard	Create Board table, containing values that allow you to create board instances in the database.

Configuration Not applicable.

oamStartStop

Syntax	Integer { oamStart(1), oamStop(2) }
Access	Read-write
OID	***p***.1.1
Description	Allows you to stop or start the NMS OAM Supervisor, or query its status. For more information, see Section 6.3.8.
Configuration	Not applicable.

oamEventMask

Syntax	Integer
Access	Read-write
OID	***p***.1.2
Description	Determines the mask to use to filter NMS OAM events. For more information, see Section 6.3.9. Reading this value returns the current event mask setting. If no mask is set, this value returns -1 (0xFFFFFFFF).
Configuration	Not applicable.

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oamAlertRegister

Syntax	Integer { enable(1), disable(2) }
Access	Read-write
OID	***p***.1.3
Description	Enables or disables the sending of NMS OAM alert messages and events as SNMP traps. For more information, see Section 6.3.9. Reading this value determines its current setting.
Configuration	Not applicable.

supervisorTable

Syntax	Object
Access	Not accessible.
OID	***p***.1.4
Description	Starts a sequence of **supervisorEntry** objects, each of which composes a row in the Supervisor Keyword table. The number of rows is exactly equal to **supervisorIndex**.
Configuration	The rows in the Supervisor Keyword table are configured by the OAM Database SNMP agent when it starts up. For more information, see Section 6.2.4.

supervisorEntry

Syntax Object

Access Not accessible.

OID ***p***.1.4.1

Description Starts a row in the Supervisor Keyword table (**supervisorTable**). Each row contains information about a Supervisor keyword. The number of rows is exactly equal to **supervisorIndex**.

Configuration The rows in the Supervisor Keyword table are configured by the OAM Database SNMP agent when it starts up. For more information, see Section 6.2.4.

supervisorIndex

Syntax	Integer
Access	Read-only
OID	***p***.1.4.1.1.***n***
Description	The keyword's index. Keywords are numbered sequentially from 1 upward.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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keywordName

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.1.4.1.2.***n***

Description A Supervisor keyword name.

Where a keyword belongs to one or more arrays or structures, the array and structure names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

kwValue

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.1.4.1.3.***n***
Description	The Supervisor keyword value.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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kwType

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.1.4.1.4.***n***

Description Indicates the type of the Supervisor keyword. Valid types are:

Type	Description
Integer	An integer.
String	A string of 0 or more characters.
Object	An EMC, board plug-in, or board managed object.

kwType is equivalent to the value of the Type qualifier for the keyword in the NMS OAM database.

Keywords of other types (for example, Array, Struct, StructAndArray) are not included as separate entries in MIB tables. For more information, see Section 6.2.3.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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kwMode

Syntax Integer { readOnly(1), readWrite(2) }

Access Read-only

OID ***p***.1.4.1.5.***n***

Description Indicates if the Supervisor keyword is read-only or read-write.

kwMode reflects the value of the keyword's ReadOnly qualifier in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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kwAllowedRange

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.1.4.1.6.***n***

Description The range of allowed values for the Supervisor keyword.

If the keyword type is Integer, and is a yes/no choice, **kwAllowedRange** contains a string of this format:

```
Nb values=2: Yes,No
```

If the keyword type is Integer, and can take a range of values, **kwAllowedRange** contains a string of this format:

`BASE` ***base*`:`*min_value* `<>` ***max_value***

...where:

- ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number).
- ***min_value*** is the minimum allowed value.
- ***max_value*** is the maximum allowed value.

For example: `BASE 10: 0 <> 65535`

If the keyword type is String, **kwAllowedRange** contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`.

If the keyword type is Object, no possible values are given.

kwAllowedRange reflects the combined values of the Base, Min, Max, and Choices qualifiers for the keyword in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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kwDescription

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.1.4.1.7.***n***

Description A short description of the Supervisor keyword.

kwDescription is equivalent to the value of the Description qualifier for the keyword in the NMS OAM database. If no description is given, **kwDescription** contains <none>.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Supervisor Keyword table is populated, see Section 6.2.5.

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oamCreateBoard

Syntax Object

Access Not accessible.

OID ***p***.1.5

Description Starts the Create Board table containing values that allow you to create board instances in the database. The objects in the Create Board table are:

Object	Description
productName	Product type of the board to create.
boardName	Name to give the created board.
boardNumber	Board number to give the created board.
applyBoardCommand	Set this to 1 to create the board based upon the **productName**, **boardName**, and/or **boardNumber** values you specified.

Configuration Not applicable.

productName

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.1.5.1
Description	Product name of the board to create. For more information, see Section 6.3.2.
Configuration	Configured by the user as necessary.

boardName

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.1.5.2
Description	Name to give the created board. For more information, see Section 6.3.2.
Configuration	Configured by the user as necessary.

boardNumber

Syntax	Integer
Access	Read-write
OID	***p***.1.5.3
Description	Number to give the created board. For more information, see Section 6.3.2.
Configuration	Configured by the user as necessary.

applyBoardCommand

Syntax	Integer { create(1), donothing(2) }
Access	Read-write
OID	***p***.1.5.4
Description	Set this value to 1 to create a new board managed object in the NMS OAM database based on the **productName**, **boardName**, and **boardNumber** values you specified. For more information, see Section 6.3.2. Reading this value always returns 2.
Configuration	Configured by the user as necessary.

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oamBoardPlugins

Syntax Object

Access Not accessible.

OID ***p***.2

Description Start of the OAM Board Plug-in table containing, for each board plug-in, a table of the plug-in's keywords, values, and qualifiers.

The objects in the OAM Board Plug-in table are:

Object	Description
boardPluginTable	Top of the table.
boardPluginEntry	Starts a row of the OAM Board Plug-in table.
boardPluginIndex	Plug-in index. This is equivalent to the index number of the `BoardPlugins[x]` keyword listing the board plug-in in the Supervisor managed object (see below).
boardPluginKwIndex	Unique index (within this table) identifying the keyword.
bpikeywordName	The keyword name, formatted as described in Section 6.2.3.
bpikwValue	The value of the keyword.
bpikwType	The type of the keyword: `Integer` or `String`.
bpikwMode	`1` indicates keyword value is read/write. `0` indicates keyword value is read-only.
bpikwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
bpikwDescription	A short description of the keyword.

Configuration Not applicable.

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boardPluginTable

Syntax	Object
Access	Not accessible.
OID	***p***.2.1
Description	Starts a sequence of **boardPluginEntry** objects, each of which composes a row in the Board Plug-in table.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

boardPluginEntry

Syntax	Object
Access	Not accessible.
OID	***p***.2.1.1
Description	Starts a row in the Board Plug-in table (**boardPluginTable**). Each row contains information about a board plug-in keyword.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

boardPluginIndex

Syntax Integer

Access Read-only

OID ***p***.2.1.1.1.***n***

Description Indicates the board plug-in to which the keyword belongs. It maps to the index value of the Supervisor keyword `BoardPlugins[x]` listing the board plug-in in the NMS OAM database. For example, if `BoardPlugins[1]=agplugin.bpi` (the AG board plug-in), all AG board plug-in keywords in the OAM Database MIB will have **boardPluginIndex** equal to 1.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

boardPluginKwIndex

Syntax	Integer
Access	Read-only
OID	***p***.2.1.1.2.***n***
Description	The keyword's index. Keywords are numbered sequentially from 1 upward.
Configuration	This value is determined when the OAM Database SNMP agent populates the Board Plug-in table as described in Section 6.2.6.

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bpikeywordName

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.1.1.3.***n***

Description A board plug-in keyword name.

Where a keyword belongs to one or more arrays or structures, the array and structure names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

bpikwValue

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.2.1.1.4.***n***
Description	The board plug-in keyword value.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

bpikwType

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.1.1.5.***n***

Description Indicates the type of the board plug-in keyword. Valid types are:

Type	Description
Integer	An integer.
String	A string of 0 or more characters.

bpikwType is equivalent to the value of the Type qualifier for the keyword in the NMS OAM database.

Keywords of other types (for example: Array, Struct, StructAndArray) are not included as separate entries in MIB tables. For more information, see Section 6.2.3.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

bpikwMode

Syntax	Integer { readOnly(1), readWrite(2) }
Access	Read-only
OID	***p***.2.1.1.6.***n***
Description	Indicates if the Supervisor keyword is read-only or read-write. **bpikwMode** reflects the value of the keyword's ReadOnly qualifier in the NMS OAM database.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

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bpikwAllowedRange

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.1.1.7.***n***

Description The range of allowed values for the board plug-in keyword.

If the keyword type is Integer, and is a yes/no choice, **bpikwAllowedRange** contains a string of this format:

```
Nb values=2: Yes,No
```

If the keyword type is Integer, and can take a range of values, **bpikwAllowedRange** contains a string of this format:

`BASE` ***base***`:`***min_value*** `<>` ***max_value***

where:

- ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number).
- ***min_value*** is the minimum allowed value.
- ***max_value*** is the maximum allowed value.

For example: `BASE 10: 0 <> 65535`

If the keyword type is String, **bpikwAllowedRange** contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`.

bpikwAllowedRange reflects the combined values of the Base, Min, Max, and Choices qualifiers for the keyword in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

bpikwDescription

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.2.1.1.8.***n***

Description A short description of the board plug-in keyword.

bpikwDescription is equivalent to the value of the Description qualifier for the keyword in the NMS OAM database. If no description is given, **bpikwDescription** contains <none>.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Plug-in table is populated, see Section 6.2.6.

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oamEMCs

Syntax Object

Access Not accessible.

OID ***p***.3

Description Starts the Extended Management Component (EMC) table containing, for each EMC, a table of the EMC's keywords, values, and qualifiers.

The objects in the Extended Management Component (EMC) table are:

Object	Description
emcTable	Top of the table.
emcEntry	Starts a row of the Extended Management Component table.
emcIndex	EMC index.
emcKwIndex	Unique index (within this table) identifying the keyword.
emckeywordName	The keyword name, formatted as described in Section 6.2.3.
emckwValue	The value of the keyword.
emckwType	The type of the keyword: `Integer` or `String`.
emckwMode	`1` indicates keyword value is read/write. `0` indicates keyword value is read-only.
emckwAllowedRange	Range of allowable values for the keyword, formatted as described in Section 6.2.3.
emckwDescription	A short description of the keyword.

Configuration Not applicable.

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emcTable

Syntax	Object
Access	Not accessible.
OID	***p***.3.1
Description	Starts a sequence of **emcEntry** objects, each of which composes a row in the Extended Management Component table.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

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emcEntry

Syntax	Object
Access	Not accessible.
OID	***p***.3.1.1
Description	Starts a row in the Extended Management Component table (**emcTable**). Each row contains information about an EMC keyword.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

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emcIndex

Syntax Integer

Access Read-only

OID ***p***.3.1.1.1.***n***

Description This value indicates the EMC to which the keyword belongs. It maps to the index value of the `ExtendedManagementComponents[x]` Supervisor keyword listing the EMC in the NMS OAM database. For example, if `ExtendedManagementComponents[1]=hotswap.emc` (the Hot Swap EMC), all Hot Swap EMC keywords in the OAM Database MIB will have **emcIndex** equal to 1.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

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emcKwIndex

Syntax	Integer
Access	Read-only
OID	***p***.3.1.1.2.***n***
Description	The keyword's index. Keywords are numbered sequentially from 1 upward.
Configuration	This value is determined when the OAM Database SNMP agent populates the Extended Management Component table as described in Section 6.2.7.

emckeywordName

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.3.1.1.3.***n***

Description An EMC keyword name.

Where a keyword belongs to one or more arrays or structures, the array and structure names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

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emckwValue

Syntax DisplayString (SIZE 0..255)

Access Read-write

OID ***p***.3.1.1.4.***n***

Description The EMC keyword value.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

emckwType

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.3.1.1.5.***n***

Description Indicates the type of the EMC keyword. Valid types are:

Type	Description
Integer	An integer.
String	A string of 0 or more characters.

emckwType is equivalent to the value of the Type qualifier for the keyword in the NMS OAM database.

Keywords of other types (for example: Array, Struct, StructAndArray) are not included as separate entries in MIB tables. For more information, see Section 6.2.3.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

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emckwMode

Syntax Integer { readOnly(1), readWrite(2) }

Access Read-only

OID ***p***.3.1.1.6.***n***

Description Indicates if the EMC keyword is read-only or read-write.

emckwMode reflects the value of the keyword's ReadOnly qualifier in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

emckwAllowedRange

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.3.1.1.7.***n***

Description The range of allowed values for the EMC keyword.

If the keyword type is Integer, and is a yes/no choice, **emckwAllowedRange** contains a string of this format:

```
Nb values=2: Yes,No
```

If the keyword type is Integer, and can take a range of values, **emckwAllowedRange** contains a string of this format:

`BASE` ***base*`:`*min_value* `<>` ***max_value***

where:

- ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number).
- ***min_value*** is the minimum allowed value.
- ***max_value*** is the maximum allowed value.

For example: `BASE 10: 0 <> 65535`

If the keyword type is String, **emckwAllowedRange** contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`.

emckwAllowedRange reflects the combined values of the Base, Min, Max, and Choices qualifiers for the keyword in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

emckwDescription

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.3.1.1.8.***n***

Description A short description of the EMC keyword.

emckwDescription is equivalent to the value of the Description qualifier for the keyword in the NMS OAM database. If no description is given, **emckwDescription** contains <none>.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Extended Management Component table is populated, see Section 6.2.7.

oamBoards

Syntax Object

Access Not accessible.

OID ***p***.4

Description Starts the OAM Boards table containing:

- The number of boards automatically detected in the system
- The total number of boards registered to NMS OAM
- A table of boards, each with their keywords, values and qualifiers
- Values that allow you to start or stop a board, test a board, delete a board instance from the database, change a board's name or number, or query its status.

The objects in the OAM Boards table are:

Object	Description
detectedBoardCount	Number of boards automatically detected in the system.
createdBoardCount	Total number of boards registered to NMS OAM.
boardTable	Board Keyword table, containing a list of boards, each with their keywords, values, and qualifiers.
boardManagementTable	Board Management table, containing values that allow you to start, stop, test, or delete a board, change a board's name or number, or query its status.

Configuration Not applicable.

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detectedBoardCount

Syntax	Integer
Access	Read-only
OID	***p***.4.1
Description	The number of boards physically detected for this board family.
Configuration	This value is updated whenever the NMS OAM automatic board detection functions are activated. For more information, see the *NMS OAM Service Developer's Reference Manual*.

createdBoardCount

Syntax	Integer
Access	Read-only
OID	***p***.4.2
Description	The number of boards created within NMS OAM for this board family.
Configuration	This value is updated whenever board managed objects are created or deleted.

boardTable

Syntax	Object
Access	Not accessible.
OID	***p***.4.3
Description	Starts a sequence of **boardEntry** objects, each of which composes a row in the OAM Boards table.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

boardEntry

Syntax	Object
Access	Not accessible.
OID	***p***.4.3.1
Description	Starts a row in the OAM Boards table (**boardTable**). Each row contains information about a board keyword.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

boardIndex

Syntax Integer

Access Read-only

OID ***p***.4.3.1.1.***n***

Description Indicates the board managed object to which the keyword belongs. It maps to the index value of the Supervisor keyword `Boards[x]` listing the board in the NMS OAM database. For example, if `Boards[1]=MyBoard`, all keywords for this board in the OAM Database MIB will have **boardIndex** equal to 1.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

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boardKwIndex

Syntax	Integer
Access	Read-only
OID	***p***.4.3.1.2.***n***
Description	The keyword's index. Keywords are numbered sequentially from 1 upward.
Configuration	Determined when the OAM Database SNMP agent populates the OAM Boards table as described in Section 6.2.8.

brdkeywordName

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.3.***n***

Description A board keyword name.

Where a keyword belongs to one or more arrays or structures, the array and structure names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

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brdkwValue

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.4.3.1.4.***n***
Description	The board keyword value.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

brdkwType

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.5.***n***

Description Indicates the type of the board keyword. Valid types are:

Type	Description
Integer	An integer.
String	A string of 0 or more characters.

brdkwType is equivalent to the value of the Type qualifier for the keyword in the NMS OAM database.

Keywords of other types (for example: Array, Struct, StructAndArray) are not included as separate entries in MIB tables. For more information, see Section 6.2.3.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

brdkwMode

Syntax	Integer { readOnly(1), readWrite(2) }
Access	Read-only
OID	***p***.4.3.1.6.***n***
Description	Indicates if the board keyword is read-only or read-write. **brdkwMode** reflects the value of the keyword's ReadOnly qualifier in the NMS OAM database.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

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brdkwAllowedRange

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.7.***n***

Description The range of allowed values for the board keyword.

If the keyword type is Integer, and is a yes/no choice, **brdkwAllowedRange** contains a string of this format:

```
Nb values=2: Yes,No
```

If the keyword type is Integer, and can take a range of values, **brdkwAllowedRange** contains a string of this format:

`BASE` ***base***`:`***min_value*** `<>` ***max_value***

...where:

- ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number).
- ***min_value*** is the minimum allowed value.
- ***max_value*** is the maximum allowed value.

For example: `BASE 10: 0 <> 65535`

If the keyword type is String, **brdkwAllowedRange** contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`.

brdkwAllowedRange reflects the combined values of the Base, Min, Max, and Choices qualifiers for the keyword in the NMS OAM database.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

brdkwDescription

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.4.3.1.8.***n***

Description A short description of the board keyword.

brdkwDescription is equivalent to the value of the Description qualifier for the keyword in the NMS OAM database. If no description is given, **brdkwDescription** contains <none>.

Configuration When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database. For more information on how the Board Keyword table is populated, see Section 6.2.8.

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boardManagementTable

Syntax Object

Access Not accessible.

OID ***p***.4.4

Description A table that allows management of boards via the OAM Database MIB. The objects in the Board Management table are:

Object	Description
boardManagementEntry	Top of the table.
boardManagementIndex	Index of the board to manage (matches the **boardIndex** of the board in the Board Keywords table).
brdName	Queries or changes the name of the board.
brdNumber	Queries or changes the board number.
brdStartStop	Starts or stops the board or indicates its status.
brdTest	Tests the board or indicates the testing status.
brdDelete	Deletes the board instance from the NMS OAM database.

Configuration Not applicable.

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boardManagementEntry

Syntax	Object
Access	Not accessible.
OID	***p***.4.4.1
Description	Starts a row in the Board Management table (**boardManagementTable**). Each row contains entries which allow you to start, stop, test, or delete a board, or query its status.
Configuration	Not applicable.

boardManagementIndex

Syntax	Integer
Access	Read-only
OID	***p***.4.4.1.1.***n***
Description	Index of the board to manage. This index matches the **boardIndex** of the board in the Board Keywords table.
Configuration	When it starts up, the OAM Database SNMP agent populates all MIB tables based upon information from the NMS OAM database.

brdName

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.4.4.1.2.***n***
Description	Sets or determines the name of the board. For more information, see Section 6.3.3.
Configuration	Not applicable.

brdNumber

Syntax	Integer
Access	Read-write
OID	***p***.4.4.1.3.***n***
Description	Sets or determines the board number of the board. For more information, see Section 6.3.4.
Configuration	Not applicable.

brdStartStop

Syntax	Integer { brdStart(1), brdStop(2) }
Access	Read-write
OID	***p***.4.4.1.4.***n***
Description	Starts or stops a board, or indicates whether it is started or stopped. For more information, see Section 6.3.5.
Configuration	Not applicable.

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brdTest

Syntax	Integer
Access	Read-write
OID	***p***.4.4.1.5.***n***
Description	Initiates board testing, or indicates if a board is currently testing or not. For more information, see Section 6.3.6. Reading this value always returns -1.
Configuration	Not applicable.

brdDelete

Syntax	Integer { enable(1), disable(2) }
Access	Read-write
OID	***p***.4.4.1.6.***n***
Description	Deletes a board managed object. For more information, see Section 6.3.7.
Configuration	Not applicable.

oamOtherObjects

Syntax Object

Access Not accessible.

OID ***p***.5

Description Starts the Other Objects table. This table is included so that future extensions to NMS OAM will not require changes to the structure of the OAM Database MIB. The objects in the Other Objects table are:

Object	Description
otherObjectsTable	Top of the table.
otherObjectsEntry	Starts a row of the Other Objects table.
otherObjectsIndex	Object index.
otherObjectsKwIndex	Unique index (within this table) identifying the keyword.
otherObjectskeywordName	The keyword name, formatted as described in Section 6.2.3.
otherObjectskwValue	The value of the keyword.
otherObjectskwType	The type of the keyword: `Integer` or `String`.
otherObjectskwMode	`1` indicates keyword value is read/write. `0` indicates keyword value is read-only.
otherObjectskwAllowedRange	The range of allowable values for the keyword, formatted as described in Section 6.2.3.
otherObjectskwDescription	A short description of the keyword.

Configuration Not applicable.

otherObjectsTable

Syntax Object

Access Not accessible.

OID ***p***.5.1

Description Starts a sequence of **otherObjectsEntry** objects, each of which composes a row in the Other Objects table.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

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otherObjectsEntry

Syntax	Object
Access	Not accessible.
OID	***p***.5.1.1
Description	Starts a row in the Other Objects table (**otherObjectsTable**). Each row contains information about a keyword.
Configuration	When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

otherObjectsIndex

Syntax	Integer
Access	Read-only
OID	***p***.5.1.1.1.***n***
Description	This value indicates the managed object to which the keyword belongs.
Configuration	When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

otherObjectsKwIndex

Syntax	Integer
Access	Read-only
OID	***p***.5.1.1.2.***n***
Description	The keyword's index. Keywords are numbered sequentially from 1 upward.
Configuration	This value is determined when the OAM Database SNMP agent populates the Other Objects table.

otherObjectskeywordName

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.5.1.1.3.***n***

Description The name of a keyword in the managed object for the object.

Where a keyword belongs to one or more arrays or structures, the array and structure names are appended to the keyword name in the table, separated by periods (.). For example, the keyword `FallBackClockSource` in the struct `HBus` which is within `Clocking` is expressed as `Clocking.HBus.FallBackClockSource`.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

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otherObjectskwValue

Syntax	DisplayString (SIZE 0..255)
Access	Read-write
OID	***p***.5.1.1.4.***n***
Description	The keyword value.
Configuration	When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

otherObjectskwType

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.5.1.1.5.***n***

Description Indicates the type of the keyword. Valid types are:

Type	Description
Integer	An integer.
String	A string of 0 or more characters.

otherObjectskwType is equivalent to the value of the Type qualifier for the keyword in the NMS OAM database.

Keywords of other types (for example: Array, Struct, StructAndArray) are not included as separate entries in MIB tables. For more information, see Section 6.2.3.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

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otherObjectskwMode

Syntax Integer { readOnly(1), readWrite(2) }

Access Read-only

OID ***p***.5.1.1.6.***n***

Description Indicates if the keyword is read-only or read-write.

otherObjectskwMode reflects the value of the keyword's ReadOnly qualifier in the NMS OAM database.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

otherObjectskwAllowedRange

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.5.1.1.7.***n***

Description The range of allowed values for the keyword.

If the keyword type is Integer, and is a yes/no choice, **otherObjectskwAllowedRange** contains a string of this format:

```
Nb values=2: Yes,No
```

If the keyword type is Integer, and can take a range of values, **otherObjectskwAllowedRange** contains a string of this format:

`BASE` ***base***`:`***min_value*** `<>` ***max_value***

...where:

- ***base*** is a mathematical base of the integer (for example, 16 for a hexadecimal number).
- ***min_value*** is the minimum allowed value.
- ***max_value*** is the maximum allowed value.

For example: `BASE 10: 0 <> 65535`

If the keyword type is String, **otherObjectskwAllowedRange** contains all the allowed strings for this keyword, separated by commas (,). For example: `YES,NO`. If any string is acceptable, this field contains `<no range>`.

otherObjectskwAllowedRange reflects the combined values of the Base, Min, Max, and Choices qualifiers for the keyword in the NMS OAM database.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

otherObjectskwDescription

Syntax DisplayString (SIZE 0..255)

Access Read-only

OID ***p***.5.1.1.8.***n***

Description A short description of the keyword.

otherObjectskwDescription is equivalent to the value of the Description qualifier for the keyword in the NMS OAM database. If no description is given, **otherObjectskwDescription** contains <none>.

Configuration When the OAM Database SNMP agent starts up, it populates all MIB tables based upon values from the NMS OAM database. For more information, see Section 6.2.4.

oamEventsTraps

Syntax Object

Access Not accessible.

OID ***p***.6

Description Starts the OAM Traps table allowing an application to receive OAM events through the MIB. The objects in the OAM Events Traps table (**oamEventsTraps**) are:

Object	Description
oamEventDescription	The last event sent back by OAM.

Configuration Not applicable.

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oamEventDescription

Syntax	String (SIZE 0..255)
Access	Read-only
OID	***p***.6.1
Description	Returns a string containing the last event sent back by OAM. For more information, see Section 6.3.9.
Configuration	Updated whenever a new OAM event is generated.

Chapter 7

Demonstration Programs

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7.1 SNMP Demonstration Programs

The demonstration programs show how you can use the information in the NMS MIBs to provide useful information to a network administrator, and how to get and set SNMP variables.

The following demonstration programs are provided:

Program	Description
snmpget	Retrieves information about the SNMP master agent on the specified host.
snmpnext	Gets the value of the next SNMP variable.
snmpset	Sets the value of the current SNMP variable.
snmpChassScan	Navigates the NmsChassis MIB, and displays information about the chassis and boards.
snmpHsMon	Monitors a CompactPCI chassis for traps.
snmpTrunkLog	Shows the status of digital trunks.

You must start the Natural Access server with `ctdaemon.exe`, and initialize the system hardware with `oamsys` before running the SNMP demonstration programs. For versions prior to Natural Access 4.0, use `agmon` instead of `oamsys`.

Note: `snmpHsMon` is the only demonstration program that supports board insertion/extraction.

7.2 Using the SNMP Demonstration Programs

All demonstration programs are run by executing the program from the command line. Each demonstration program resides in its own directory under `\nms\ctaccess\demos\snmp` (or the `/opt/nms/ctaccess/demos/snmp` directory under UNIX), along with the source code and makefile.

snmpget

Purpose

Demonstrates SNMP **get**. Retrieves and displays information about a specified SNMP agent running at a specified IP address.

Usage

`snmpget` ***address nmssnmpoid options***

Use the following parameters:

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.
nmssnmpoid	OID of an object in one of the MIBs available on the host for which you wish to see information. The default is `sysDescr`.

Valid ***options*** include:

Option	Description
`-v1`	Use SNMPv1 (default).
`-v2`	Use SNMPv2.
`-c`***community_name***	Specify a community name. The default is `public`.
`-r`***n***	Number of retries. The default is 1 retry.
`-t`***n***	Timeout in hundredths of a second. The default is 100 (1 second).

Procedure

To run *`snmpget`*:

1. From the command line, navigate to the *`\nms\ctaccess\demos\snmp\snmpget`* directory (or the *`/opt/nms/ctaccess/demos/snmp/snmpget`* directory under UNIX).
2. Enter the following:

   ```
   snmpget localhost
   ```

An example of running this command is:

```
< snmpGet.exe localhost
> SNMP++ Get to localhost SNMPV1 Retries=1 Timeout=100ms Community=public
> oid = 1.3.6.1.2.1.1.1.0
> Value = Hardware: x86 Family 6 Model 3 Stepping 4 AT/AT COMPATIBLE  -
> Software: Windows NT Version 4.0  (Build Number: 1381 Uniprocessor Free )
```

snmpnext

Purpose

Demonstrates SNMP **get-next**. Retrieves the value of the next object after a specified OID.

Usage

`snmpnext` ***address cnmssnmpoid options***

Use the following parameters

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.
nmssnmpoid	OID of an object in one of the MIBs available on the host for which you wish to see information. The default is `sysDescr`.

Valid ***options*** include:

Option	Description
`-v1`	Use SNMPv1 (default).
`-v2`	Use SNMPv2.
`-c`***community_name***	Specify a community name. The default is `public`.
`-r`***n***	Number of retries. The default is 1 retry.
`-t`***n***	Timeout in hundredths of a second. The default is 100 (1 second).

Procedure

To run *snmpnext*:

1. From the command line, navigate to the *\nms\ctaccess\demos\snmp\snmpnext* directory (or the */opt/nms/ctaccess/demos/snmp/snmpnext* directory under UNIX).
2. Enter the following:

   ```
   snmpnext 10.1.20.46 1.3.6.1.2.1.1.1.0
   ```

An example of running this command is:

```
>snmpnext 10.1.20.46 1.3.6.1.2.1.1.1.0
SNMP++ GetNext to 10.1.20.46 SNMPV1 Retries=1 Timeout=1000ms
Community=public
Oid = 1.3.6.1.2.1.1.2.0
Value = 1.3.6.1.4.1.311.1.1.3.1.1
```

snmpset

Purpose

Demonstrates SNMP **set**. Sets the value of a specified SNMP object.

Usage

`snmpset` ***address nmssnmpoid options***

Use the following parameters:

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.
nmssnmpoid	OID of an object in one of the MIBs available on the host for which you wish to see information. The default is `sysDescr`.

Valid ***options*** include:

Option	Description
`-v1`	Use SNMPv1 (default).
`-v2`	Use SNMPv2.
`-c`***community_name***	Specify a community name. The default is `public`.
`-r`***n***	Number of retries. The default is 1 retry.
`-t`***n***	Timeout in hundredths of a second. The default is 100 (1 second).

Procedure

To run *`snmpset`*:

1. From the command line, navigate to the *`\nms\ctaccess\demos\snmp\snmpset`* directory (or the *`/opt/nms/ctaccess/demos/snmp/snmpset`* directory under UNIX).
2. Enter the following:

```
snmpset localhost 1.3.6.1.4.1.2628.2.2.4.2.0
```

Note: An example of running this command to set the chassBoardTrapEnable follows:

```
>snmpSet.exe localhost 1.3.6.1.4.1.2628.2.2.4.2.0
>SNMP++ Set to localhost SNMPV1 Retries=1 Timeout=100ms
>CNmsSnmpOid = 1.3.6.1.4.1.2628.2.2.4.2.0
>Current Value = 2
>Value Type is Integer
>Value ?
```

The program asks for new value. In this example, enter `1` to enable traps.

```
<Value ?1
>Set Status = Success
```

snmpChassScan

Purpose

Demonstrates how to navigate the chassis MIB, how to retrieve chassis type and description, and how to navigate by bus, recognize ISA and PCI boards, and show board description and status information.

Usage

`nmsChassScan` ***address options***

Use the following parameter:

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.

Valid ***options*** include:

Option	Description
`-c`***community_name***	Specify a community name. The default is `public`.
`-r`***n***	Number of retries. The default is 1 retry.
`-t`***n***	Timeout in hundredths of a second. The default is 100 (1 second).

Polling is set interactively by the application. See the example in the Procedure section below.

Procedure

To run *`nmsChassScan`*:

1. From the command line, navigate to the *`\nms\ctaccess\demos\snmp\snmpchassscan`* directory (or the *`/opt/nms/ctaccess/demos/snmp/snmpchassscan`* directory under UNIX).
2. Enter the following:

   `nmsChassScan`

The following example shows running *nmsChassScan*:

```
< snmpChassScan.exe
> SNMP Demonstration and Test Program  V.3.0 Nov 15 1999
> Natural MicroSystems Corporation.

>Usage:
>snmpChassScan [Address | DNSName] [options]
>Address:  default is 127.0.0.1
>options: -cCommunity_name, specify community default is 'public'
>         -rN , retries default is N = 1 retry
>         -tN , timeout in hundredths-seconds default is N = 100 = 1 second
>
>H Help  S Sys info  L Board list  P<N> Poll Interval  Q Quit
>
>SEND A REQUEST FOR SYSTEM INFO TO: 10.1.20.45
>System information:
>System:        Hardware: x86 Family 6 Model 3 Stepping 4 AT/AT COMPATIBLE
- >Software: Win
>dows NT Version 4.0  (Build Number: 1381 Uniprocessor Free )
>SysUpTime:     1:22:15.66
>SysContact:    Ilya Lugin
>Computer name: ILUGIN
>Location:      NMS
>
>SEND A REQUEST FOR NMS BOARDS TO: 10.1.20.45
>             ISA bus
>Board 0:       AgE1 Status:OnLine
>Board 3:       AgT1 Status:OnLine
>             PCI bus
>Board 1:       Ag-Quad-E1 Segment:1 Slot:7 Status:OnLine
>Board 2:       Ag-Quad-T1 Segment:1 Slot:6 Status:OnLine
>
```

snmpHsMon

Purpose

Demonstrates how to monitor a CompactPCI chassis: how to receive traps when board status changes, and how to remotely insert or extract a board.

Usage

`snmpHsMon` ***make lowercase***

Use the following parameter:

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.

snmpHsMon is similar to the *hsmon* utility. For more information, see the *NMS OAM System User's Manual* for Natural Access 4.0 or later, or the *Hot Swap Manager Developer's Reference Manual* for Natural Access 3.x.

Procedure

To run *snmpHsMon*:

1. From the command line, navigate to the *\nms\ctaccess\demos\snmp\snmphsmon* directory (or the */opt/nms/ctaccess/demos/snmp/snmphsmon* directory under UNIX).
2. Enter the following:

   snmpHsMon

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The following example shows running *snmpHsMon*:

```
>snmpHsMon.exe 10.1.20.46
SNMP Demonstration and Test Program  V.3.0 Nov 15 1999
Natural MicroSystems Corporation.

h  Help     r  Refresh    i<N> Insert    e<N> Extract  Q  Quit

SEND A REQUEST FOR SYSTEM INFO TO: 10.1.20.46
System information:
System:       Hardware: x86 Family 5 Model 4 Stepping 3 AT/AT COMPATIBLE  -
Software: Win dows NT Version 4.0  (Build Number: 1381 Uniprocessor Free )
SysUpTime:     1 day 1:34:44.93
SysContact:    Joseph Daigle
Computer name: CENTELLIS-3
Location:      NMS

SEND A REQUEST FOR NMS BOARDS TO: 10.1.20.46
             PCI bus
Board 0:       Ag-CPCI-Quad-E1 Segment:1 Slot:10 Status:OffLine
Board 1:       Ag-CPCI-Quad-T1 Segment:1 Slot:11 Status:OffLine
Board 3:       Ag-CPCI-Quad-T1 Segment:1 Slot:15 Status:OffLine
Board 2:       Ag-Quad-T1 Segment:1 Slot:13 Status:OffLine

>
< 00:20:24   3 Board OnLinePending
< 00:20:24   1 Board OnLinePending
< 00:20:24   3 Board OnLine
< 00:20:24   1 Board OnLine
< 00:20:24   0 Board OnLinePending
< 00:20:24   0 Board OnLine
< 00:20:24   2 Board OnLinePending
< 00:20:24   1 Board OffLinePending
< 00:20:24   1 Board OffLine
< 00:20:24   2 Board OnLine
< 00:20:24   3 Board OffLinePending
< 00:20:24   3 Board OffLine
< 00:20:24   0 Board OffLinePending
< 00:20:24   0 Board OffLine
>q
```

snmpTrunkLog

Purpose

Shows the status of digital trunks of each board in a chassis.

Usage

`snmpTrunkLog` ***address options***

Use the following parameters:

Parameter	Description
address	The address or DNS name of a local or remote host running an SNMP agent about which to return information.

Valid ***options*** include:

Option	Description
`-c`***Community_name***	Specify a community name. The default is `public`.
`-r`***n***	Number of retries. The default is 1 retry.
`-t`***n***	Timeout in hundredths of a second. The default is 100 (1 second).

`snmpTrunkLog` is similar to the *`trunkmon`* utility. See the *NMS OAM System User's Manual* for more information.

Procedure

To run *`snmpTrunkLog`*:

1. From the command line, navigate to the *`\nms\ctaccess\demos\snmp\snmptruklog`* directory (or the *`/opt/nms/ctaccess/demos/snmp/snmptruklog`* directory under UNIX).
2. Enter the following:

   `snmpTrunkLog 10.1.20.45`

The following example shows *snmpTrunkLog* being run:

```
> snmpTrunkLog
SNMP Demonstration and Test Program  V.3.0 Nov 15 1999
Natural MicroSystems Corporation.

Usage:
snmpChassScan [Address | DNSName] [options]
Address:  default is 127.0.0.1
options: -cCommunity_name, specify community default is 'public'
         -rN , retries default is N = 1 retry
         -tN , timeout in hundredths-seconds default is N = 100 = 1 second

h  Help     S  Sys info    L  Trunk list    Q  Quit

SEND A REQUEST FOR SYSTEM INFO TO: 10.1.20.45
System information:
System:       Hardware: x86 Family 6 Model 3 Stepping 4 AT/AT COMPATIBLE  -
Software: Windows NT Version 4.0  (Build Number: 1381 Uniprocessor Free )
SysUpTime:     1:59:37.45
SysContact:    Ilya Lugin
Computer name: ILUGIN
Location:      NMS

SEND A REQUEST FOR TRUNKS TO: 10.1.20.45
Interface:1 Board:0 (AgE1)  Trunk:0 Status: Loss of frame, NoSgnl
Interface:2 Board:1 (Ag-Quad-E1)  Trunk:0 Status: Loss of frame, NoSgnl
Interface:3 Board:1 (Ag-Quad-E1)  Trunk:1 Status: Loss of frame, NoSgnl
Interface:4 Board:1 (Ag-Quad-E1)  Trunk:2 Status: Loss of frame, NoSgnl
Interface:5 Board:1 (Ag-Quad-E1)  Trunk:3 Status: Loss of frame, NoSgnl
Interface:6 Board:2 (Ag-Quad-T1)  Trunk:0 Status: In service
Interface:7 Board:2 (Ag-Quad-T1)  Trunk:1 Status: Loss of frame, NoSgnl
Interface:8 Board:2 (Ag-Quad-T1)  Trunk:2 Status: In service
Interface:9 Board:2 (Ag-Quad-T1)  Trunk:3 Status: Loss of frame, NoSgnl
Interface:10 Board:3 (AgT1)  Trunk:0 Status: Loss of frame, NoSgnl
```

Appendix Athe

WBEM Support Under Windows

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Introduction

The Distributed Management Task Force (DMTF) has launched the Web-Based Enterprise Management (WBEM) initiative that extends the Common Information Model (CIM) to represent management objects. This Common Information Model is an extensible data model for logically organizing management objects in a consistent, unified manner in a managed environment.WBEM is a technology that establishes management infrastructure standards and provides a standardized way to access information from various hardware and software management systems in an enterprise environment. Using WBEM standards, developers can create tools and technologies that reduce the complexity and costs of enterprise management.WBEM provides a point of integration through which data from management sources can be accessed, and it complements and extends existing management protocols and instrumentation such as Simple Network Management Protocol (SNMP), Desktop Management Interface (DMI), and Common Management Information Protocol (CMIP).

The Microsoft Windows Management Instrumentation (WMI) technology is the Microsoft implementation of the WBEM initiative. The Windows Management Instrumentation (WMI) technology is a management infrastructure that supports the syntax of CIM, the Managed Object Format (MOF), and a common programming interface. The MOF syntax defines the structure and contents of the CIM schema in human and machine-readable form. Windows Management Instrumentation offers a powerful set of services, including query-based information retrieval and event notification. These services and the management data are accessed through a Component Object Model (COM) programming interface. The WMI scripting interface also provides scripting support.

When running Windows NT 4.0 or Windows 2000 installed with SMNP and WMI services, SNMP data can be accessed as WBEM data through WMI mechanisms. The WMI SNMP provider (optionally installed) performs the link between SNMP and WMI. The Microsoft SNMP provider comes with additional MIB and MOF files reflecting the standard RFC. This appendix describes how to install and test a configuration allowing interaction between NMS SNMP agents and a WBEM/WMI script or program.

Some demonstration programs are included to show how you can use WBEM to retrieve information contained in the NMS subagents. These programs are for Windows only. Then can be found in `\nms\ctaccess\demos\snmp\wbem`.

Installing Microsoft WMI and the WMI SNMP Provider

To install Microsoft WMI and the WMI SNMP Provider:

1. Verify your SNMP installation.
2. Obtain the installation files if they are not included on the Windows NT installation CD.
3. Install the software.
4. Verify the SNMP Provider installation.

Each step is discussed below in detail.

Verifying the SNMP Installation

The SMNP provider can interact with an SNMP agent only when the agent is working properly. To make sure the SNMP data will be available through WBEM/WMI, first check the NMS-related information using the demonstration programs described in Chapter 7 of this manual.

Obtaining and Installing the Software

The following sections describe how to obtain and install the Microsoft WMI and WMI SNMP Provider software under different Windows NT installations.

Windows 2000 Server and Advanced Server

The WMI core is installed by default under Windows 2000. However, the SNMP provider must be manually installed. To do so, run the *wbemsnmp.exe* installation program located in the *System32\WBEM* directory of the current installation, or in the *\i386* directory of the Windows 2000 installation CD.

Windows 2000 Professional

As with the Windows 2000 Server, the WMI core is installed by default, but the SNMP provider must be manually installed. If the software is not located on the installation CD, you can download the installation file *wmisnmp.exe* from Microsoft's Web site. This file can be found at:
http://download.microsoft.com/download/platformsdk/SNMPX86/1.5/NT45/EN-US/wmisnmp.exe

Windows NT 4.0

Unlike Windows 2000, the WMI core is not installed with the system and no part of WMI is present on the installation CD. To install this software, download *wmicore.exe* from Microsoft's Web site. This program installs WMI and the SNMP provider. This file can be found at:
http://download.microsoft.com/download/platformsdk/wmicore/1.5/W9XNT4/EN-US/wmicore.EXE

Note: Requires NT Service Pack 4 or later.

The WMI SDK for Windows 2000 and Windows NT 4.0 can be found at:
http://download.microsoft.com/download/platformsdk/sdkx86/1.5/NT45/EN-US/wmisdk.exe

Verifying the SNMP Provider Installation

The SNMP provider installation automatically creates the following namespaces with WMI:

- `\root\snmp\localhost`
- `\root\snmp\SMIR`

To check that the namespaces have been properly created, browse for the namespaces in the WMI Control dialog box, shown in Figure 24:

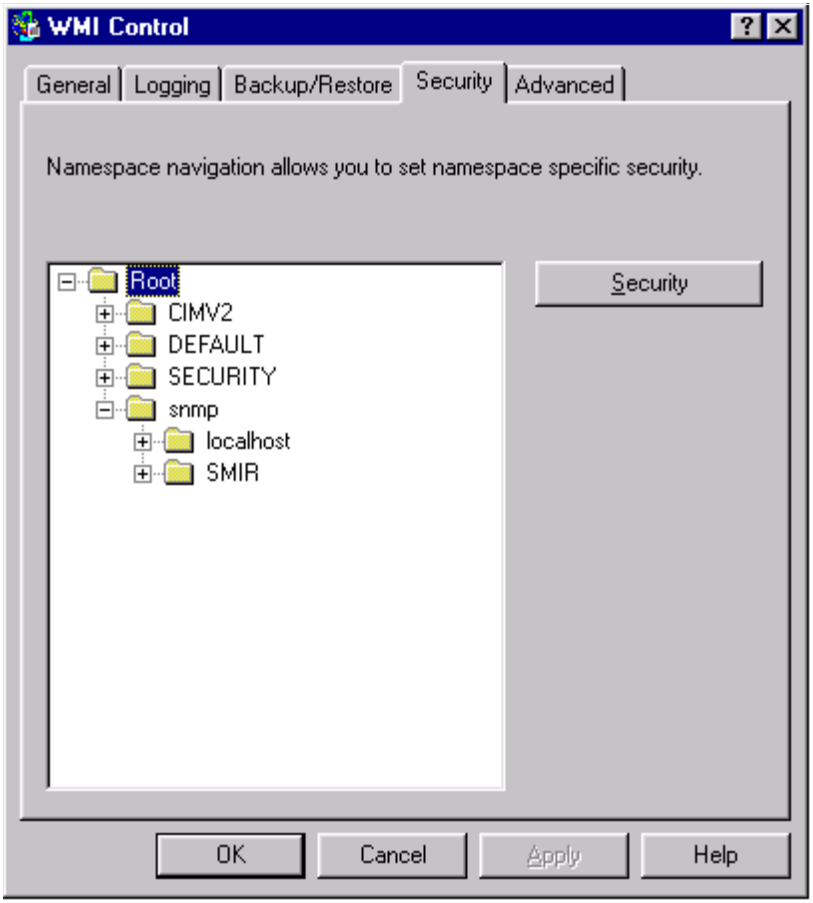

Figure 24. WMI Control Dialog Box

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To access this dialog box in Windows 2000:

1. Double-click on **Administrative Tools**.

   The Administrative Tools window appears.

2. Double-click on **Computer Management**.

   The Computer Management window appears.

3. Under **Services and Applications**, highlight **WMI Control**.

4. In the **Action** menu, click **Properties**.

   The WMI Control Properties dialog box appears.

5. Click on the **Security** tab in this dialog box.

To access the WMI Control dialog box in Windows NT 4.0:

1. Click **Start --> Programs --> Administrative Tools --> WMI Config Manager**.

   The WMI Control Properties dialog box appears.

2. Click on the **Security** tab in this dialog box.

You can also check namespaces using the CIM studio in the WBEM SDK (if installed).

Installing NMS MOF Files in the WBEM Repository

The following MOF files can be found in the `\nms\ctaccess\demos\snmp\wbem` directory:

Filename	Description
`nmsChassis.mof`	MOF file of the Chassis MIB.
`nmsTrunk.mof`	MOF file of the Trunk MIB.
`nmsOamDatabase.mof`	MOF file of the OAM Database MIB.
`nmsSoftRev.mof`	MOF file of the Software Revision MIB.
`nmsRtp.mof`	MOF file of the RTP MIB. Installed with the Fusion package.

If the namespaces are properly created, SNMP-related MOF files can be added into the CIMOM repository. To do so:

1. Open an MS-DOS console.
2. Navigate to the directory `\nms\ctaccess\demos\snmp\wbem`
3. Enter the following for each MOF file: `mofcomp` ***mof_filename***

   where ***mof_filename*** is the name of the MOF file associated with the component to start.

   `mofcomp` responds with information similar to the following:

```
Parsing MOF file: nmsChassis.mof
     MOF file has been successfully parsed
     Storing data in the repository…
Done!
```

To view the contents of the repository, enter:

```
smi2smir /l
```

Information like the following appears:

```
smi2smir : Version 1.50.1085.0000

smi2smir : Modules in the SMIR :
"NMS_CHASSIS"
```

Note: Under certain circumstances, the repository is not updated correctly by the *mofcomp* utility. If you experience this problem, do the following:

a. Delete the entire repository by entering: `smi2smir /p`

b. Add the MOF files as described in the above procedure.

c. Stop the WMI service by entering: `net stop winmgmt`

d. Restart the WMI service by entering: `net start winmgmt`

The WMI repository should be correctly set up.

Testing MOF Files

Once the MOF files have been successfully compiled and inserted, test your setup using one of the SNMP enumeration example programs provided with the NMS WBEM software:

Program	Description
enumsnmp.js	A JScript program which enumerates SNMP objects in the system.
enumsnmp.htm	An HTML file containing an embedded JScript program, which enumerates SNMP objects in the system.

Both programs can be found in *\nms\ctaccess\demo\snmp\wbem*.

Note: The console mode WSH interpreter is faster than using the Windows WSH interpreter or the embedded Jscript.

Using enumsnmp.js

To launch *enumsnmp.js*, you can do either of the following:

- Double click on the file *enumsnmp.js* in a Windows Explorer window.

  This launches the script with *wscript.exe*, the default WSH (Windows Scripting Host) interpreter. If *enumsnmp.js* is launched this way, a dialog box appears for each SNMP object found through WBEM and for each property/value pair.

- Open an MS DOS console window, and enter: `cscript enumsnmp.js`

  If *`enumsnmp.js`* is launched this way, the console mode WSH interpreter (*`cscript.exe`*) is used instead of *`wscript.exe`*, and the entire list of SNMP objects, properties and values in the system appears in the console window.

  The following is example partial output of *`enumsnmp.js`* when launched with *`cscript`*:

```
C:\NMS\CTAccess\Demos\snmp\wbem>cscript enumsnmp.js
Microsoft (R) Windows Script Host Version 5.1 for Windows
Copyright (C) Microsoft Corporation 1996-1999. All rights reserved.

Object of class : SNMP_OAMDATABASE_MIB_oamCreateBoard : 4 propertie(s)
   Property : applyBoardCommand         Value : donothing
   Property : boardName         Value :
   Property : boardNumber               Value : -1
   Property : productName               Value :
Object of class : SNMP_OAMDATABASE_MIB_emcTable : 8 propertie(s)
   Property : emcIndex          Value : 1
   Property : emckeywordName            Value : Name
   Property : emckwAllowedRange         Value : <no range>
   Property : emckwDescription          Value : <none>
   Property : emcKwIndex                Value : 1
   Property : emckwMode         Value : readOnly
   Property : emckwType         Value : Object
   Property : emckwValue                Value : clkmgr.emc
Object of class : SNMP_OAMDATABASE_MIB_oamEventsTraps : 1 propertie(s)
   Property : oamEventDescription               Value :
Object of class : SNMP_OAMDATABASE_MIB_boardPluginTable : 8 propertie(s)
   Property : boardPluginIndex          Value : 1
   Property : boardPluginKwIndex                Value : 1
   Property : bpikeywordName            Value : BootDiagnosticLevel
   Property : bpikwAllowedRange         Value : Base 10: 0 <> 3
   Property : bpikwDescription          Value : <none>
   Property : bpikwMode         Value : readWrite
   Property : bpikwType         Value : Integer
   Property : bpikwValue                Value : 0
Object of class : SNMP_OAMDATABASE_MIB_oamBoards : 2 propertie(s)
   Property : createdBoardCount         Value : 0
   Property : detectedBoardCount                Value : 0
Object of class : SNMP_OAMDATABASE_MIB_oamSupervisor : 3 propertie(s)
   Property : oamAlertRegister          Value : disable
   Property : oamEventMask              Value : -1
   Property : oamStartStop              Value : oamStop
Object of class : SNMP_OAMDATABASE_MIB_supervisorTable : 7 propertie(s)
   Property : keywordName            Value : ExtendedManagementComponents[0]
            .
            .
            .
```

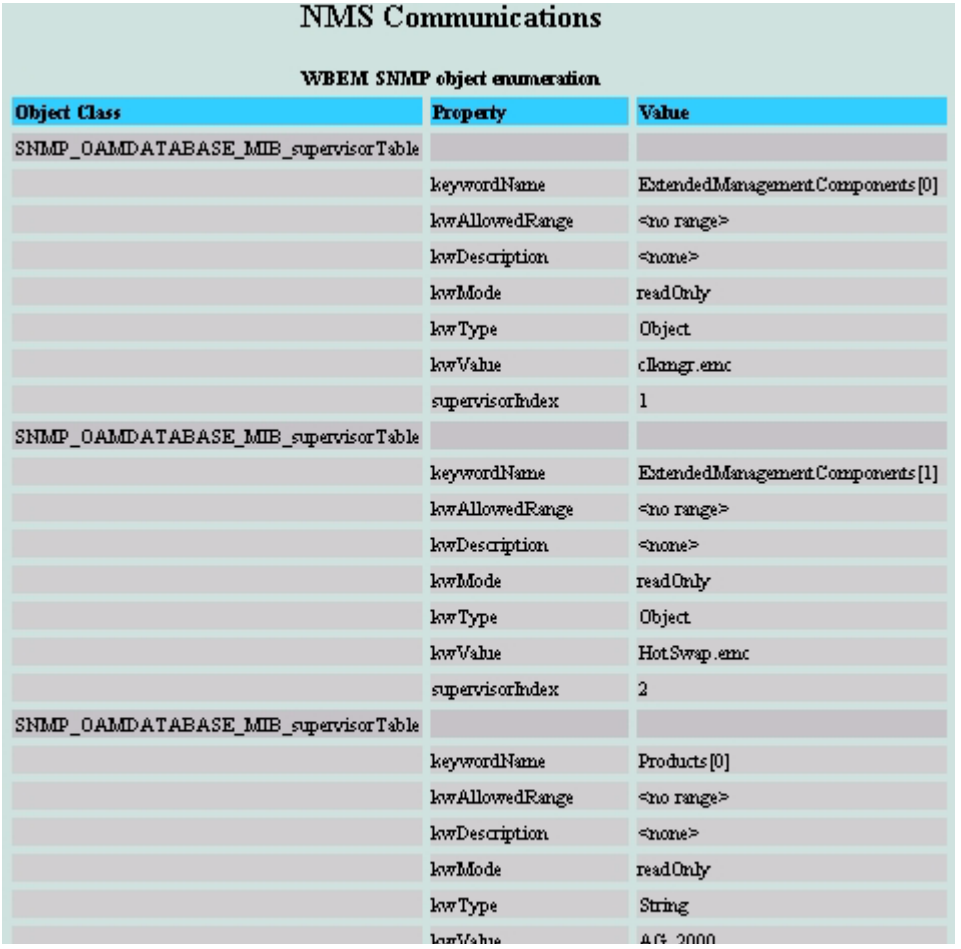
Using enumsnmp.htm

To launch *enumsnmp.htm*:

Launch Internet Explorer and open the file.

Note: If you already have an Internet Explorer window opened, you can simply drag and drop *enumsnmp.htm* into the Internet Explorer window.

Figure 25 shows the results output by *enumsnmp.htm* when opened in the Internet Explorer:



NMS Communications

WBEM SNMP object enumeration

Object Class	Property	Value
SNMP_OAMDATABASE_MIB_supervisorTable		
	keywordName	ExtendedManagementComponents[0]
	kwAllowedRange	<no range>
	kwDescription	<none>
	kwMode	readOnly
	kwType	Object
	kwValue	clkmgr.emc
	supervisorIndex	1
SNMP_OAMDATABASE_MIB_supervisorTable		
	keywordName	ExtendedManagementComponents[1]
	kwAllowedRange	<no range>
	kwDescription	<none>
	kwMode	readOnly
	kwType	Object
	kwValue	HotSwap.emc
	supervisorIndex	2
SNMP_OAMDATABASE_MIB_supervisorTable		
	keywordName	Products[0]
	kwAllowedRange	<no range>
	kwDescription	<none>
	kwMode	readOnly
	kwType	String
	kwValue	AGt 2000

Figure 25. enumsnmp.htm Output

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